The Wetzmann Retaining Dam.

BY PAUL GRUBER.

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The principles of the action of the torrential streams, developed by Alexander Surrell in 1842, have been successfully applied to extensive works in the French Alps.

The remedies used to neutralize the damaging influence of the torrential streams are reforesting the mountain slopes and erecting cross dams or retaining dams. Such structures have been built long before Surrell made his investigations, but their effect and the nature of their action was little understood. Surrell's methods to clear this intricate question are yet known little outside of France. It will be of interest to give a short account of his views and to describe a retaining dam, actually built. The line *B L* (Fig. 1.) presents a mountain slope, on which a torrential stream commences to form, which will be first noticed at the foot of the slope. The part *P R T* of the slope is washed down and deposited in the valley bottom along the base of the slope

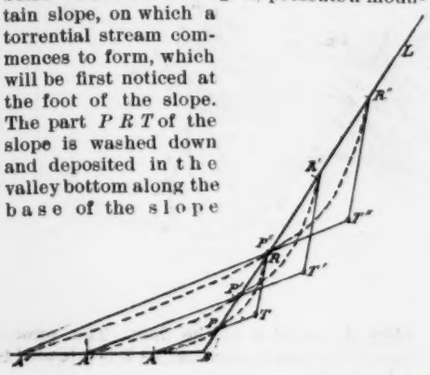

FIG. 1.

A B P. After the first rain an additional part of the slope is washed down, *P' T' R'* and deposited in *A' B P'*; this is repeated *P'' R'' T'* being deposited in *A'' B T''* and so on. The region of the torrent is divided into two distinctly different divisions, one being the "region of wash" and the other the "region of deposit." The region between these two is in a state of rest; it is not confined to one certain locality but moves sometimes down stream but mostly up stream, as can be seen by carefully studying Fig. 1. The latter shows also, that the regions of wash and of deposit are continuously enlarged by the causes mentioned, raising the region of deposit gradually. The outlines of washouts and deposits are not straight, that of the washouts being always a concave line, while that of the deposits forms often a convex curve. The latter is explained by the fact that the water current separates the detritus according to its size, the heavier parts requiring a larger transporting power being deposited first, while the lighter and smaller sediment is carried on further. Large rocks may run ahead of the smaller detritus, and form dams by which the profile of the talus will assume a convex shape; this can occur only immediately after the landslide takes place. As soon as regular conditions occur again, the profile of the talus will reassume a concave form. The washouts and the deposits will continue until a time when the region of wash can furnish only such amount of material as can be transported into the region of deposit. When the grade is equalized, so that the transport of detritus is equal in both regions, then the increase of the talus ceases. This state can be called the "profile of equal action"; which, however, is not yet a state of permanent inactivity. As soon as the water of the torrent reaches the region of deposit free of detritus, it will act again the same way as it did before in the region of wash. Washouts and scourings will occur on the surface of the talus, its slope will become flatter and flatter. The change of the profile of equal action will continue until the slope of the talus is so flat that the water cannot transport any sediment. When this period occurs where the transporting power of the water and the resistance of the detritus are equal, no more sediment is transported. Then the longitudinal profile of the torrent has assumed the last form, which may be called the "profile of equilibrium" (*Philipp Breton "Mémoire sur les barrages de retenue des graviers.* 1867). This profile is different in different kinds of detritus, depending upon the geological formation of the watershed. It will always, however, be nearly horizontal at its valley end and vertical at the beginning in the mountains. When the torrent, left to itself, has passed through all the changes of its profile mentioned, then complete rest will exist and clear water will run off. If the bottom of the torrent, is washed out to solid rock in certain places, these sections will not conform to the regular concave profile, but will form cataracts. This, however, is only a local irregularity and does not destroy the general uniform curve of the profile. If large sections of the torrent pass through gorges formed of barren, rocky walls, where no wash occurs, the same should be used for the erection of dams to store debris, coming from above. Those sections of the torrent where washouts and transportation of sediment take

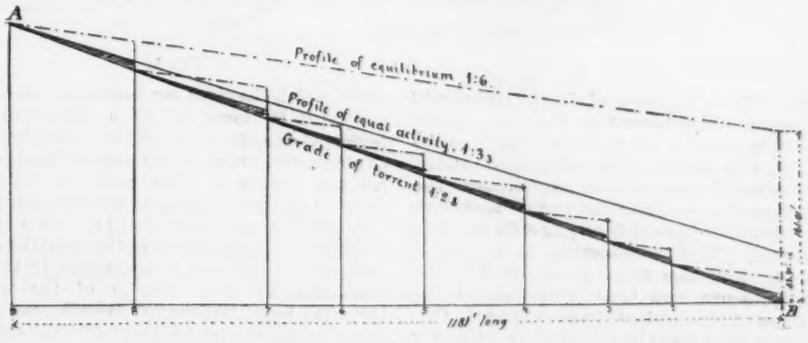

FIG. 2.

place must be provided with structures tending towards creating an equilibrium in the activity of the torrent.

All works which are proposed to contribute to the improvement of the torrent, must be done in the "region of wash." As nature seems to intend to create and maintain the profile of equilibrium, the best solution of the question would be to assist in its development. But the structures necessary for the artificial creation of this profile are too expensive; we have to be satisfied to create and maintain the profile of equal activity, a forerunner of the profile of equilibrium.

A B in Fig. 2 represents a part of a torrential stream, which shall be improved so that it cannot do any damage to the lower parts of the valley. The natural grade in this case is 1885 feet per mile, or 1 in 2.8 feet while the the grade of the profile of equal activity is 1600 feet per mile, or 1 foot in 3.3 feet. The aggregate height, the lower end of this section has to be raised to obtain this grade, is then: $h = x - y = (2.8 : 1 :: 1181 : x) - (3.3 : 1 :: 1181 : x) = 421.78 - 357.88 = 63.90$ feet. The several crossdams to be erected, must be so located, that the grade line from the toe of one to the crest of the other is equal to the grade of the profile of equal activity. The different dams will have different heights, according to local conditions and to the distance to the next dam. The aggregate height of all the dams must be equal to the height as mentioned above. As this profile is only in a state of temporary rest and the development of the profile of equilibrium commences immediately after the formation of the profile of equal activity has been accomplished, it is necessary to secure the sections 1—2, 2—3, 3—4 etc., by additional works, as planting of breast, erection of hurdles and hedges, crossways and lengthwise, etc. If it had been attempted to create artificially the profile of equilibrium, which has a grade of 6 : 1, the aggregate height of dams would be $h = x - z = (2.8 : 1 :: 1181 : x) - (6 : 1 :: 1181 : 2) = 421.78 - 196.83 = 224.95$ feet, or $224.95 - 63.90 = 161.05$ feet more than before, which proves that economy requires to be satisfied with the profile of equal activity. All structures used in these improvements, being either hurdle and hedge work, or of lumber or masonry, have the one purpose only, to create and to maintain a certain grade for a certain length of the torrent; the storage of detritus, naturally connected with it, is of secondary importance. These structures secure the bottom of the torrent, and may be called "solidifying dams." In such parts of the watershed, where only a storage of debris, brought down from the higher mountains, is intended, structures, called "debris-storing dams," are erected. They are of less importance than the dams mentioned above; the selection of their location depends only upon the capacity ot the reservoir formed by them, which should be as large as possible. After this reservoir is filled up, its usefulness is at an end.

One of the largest dams built to improve the river Gail (Province of Carinthia, Austria), is the Wetzmann dam, constructed in 1883-84. Its purpose is to retain the detritus coming from the upper part of the river Gail, being called Lessach valley, until it is possible to improve the watershed (81,545 acres) permanently by reforesting.

The destructions of the high water of 1882 showed the pressing necessity of the structure. The total amount of detritus deposited by high water during the fall of 1882 along the valley, 121 miles long, was 2,000,000 cubic yards. The watershed of the Lessach valley must be closed by the Wetzmann dam, to protect the improvements in course of construction below the same.

The present capacity of the dam, the same being 16.4 feet high above the water level is 114,000 cubic yards (Fig. 3) which will be increased by raising the dam to 39.4 feet to 1,083,000 yards. To ascertain the length of time this dam will be effective, observations made on a similar structure can be used. The Osseliken dam, built in 1877, closes up a region furnishing large amounts of detritus; its capacity is 42,000 cubic yards. At present it is not filled up to such an extent, that the detritus would flow over its crest; it will be effective yet for eight years. The watershed is 7,035 acres, of which the wooded area of 3,410 acres must be deducted, furnishing but very little sediment. The amount of detritus brought down during eight years was 42,000 cubic yards, or per year 5,250 cubic yards, be-

ing derived from an area of 7,035 — 3,410 = 3,625 acres. This gives the depth of the annual wash as 0.00089 feet or a little more than one-hundredth of an inch.

The area of the Lessach valley liable to furnish detritus is 81,545 — 32,258 = 49,287 acres. If the annual wash is taken as 0.00089 feet then the total amount of detritus washed down is

$$\frac{2{,}146{,}941{,}720 \times 0.00089}{27} = 70{,}770 \text{ cubic yards.}$$

When the dam is built up to its full height of 39.4 feet, no sediment will be carried down for fifteen years,

$$\left(\frac{1{,}083{,}000}{70{,}770}\right) = 15$$

provided no extraordinary freshets should occur. The reforesting of the watershed will have been well advanced at the end of this period, improving the upper sections permanently. The dam must be constructed solidly, so that it will stand under all conditions. The Wetzman dam has been built as an arch with a vertical axis (Figs. 4-7) having a diameter of 131.2 feet. The cross-section is shown in Fig. 7. The dam must resist at first the water-pressure and then permanently the pressure of the detritus stored behind it. Calculations were made in reference to its power to resist a tipping and a sliding movement, assuming that the masonry weighs 4,210 pounds per cubic yard, the detritus 2,980 pounds and the natural slope of the latter as 30 degrees. The arch shape was not considered in the calculation, but it increases the strength. The result of the calculation was that the pressure of the water is much larger than that of the detritus; therefore the safety of the dam will increase with the increase of deposits. The dam, however, is also exposed to sudden shocks, produced by logs and large rocks brought down by freshets.

Nearly the entire foundation of the dam was made of concrete; the hourly flow of water during the time of construction amounted to 39,600 gallons, making it impossible to keep the excavations dry. The dam was begun in September, 1883, and had to be finished before the spring high water commenced, that is before May, 1884. The space was rather confined, permitting only a small force of laborers. A trestlework with a travelling derrick was erected. The work was completed in April, 1884, at a total cost of $8,322. During the construction, the water was led away through three openings, each 5 feet high and 3.3 feet wide (Fig. 4). These furnished a cheap and easy drainage during the time of construction, and also served to let floating matter and light sediment pass through until the reservoir was filled up. The fine sediment, which the river can transport easily, is carried to the lower valleys or remains in the region of deposit, where it favors the growth of plants and trees. This has been the case at all the numerous dams built in Southern France; all of them have drainage openings.

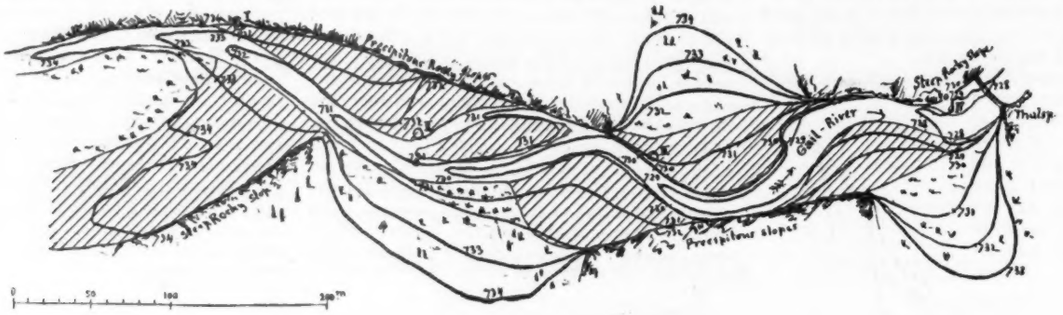

FIG. 3.

It cannot be recommended to leave a large number of drainage holes in the dam; the construction of the dam is unnecessarily inconvenienced by the drainage of the water through long box-drains, besides the frequent interruption of the masonry is liable to weaken the same. The unequal distribution of the drainage-holes make the strain upon the apron uneven; they also affect the deposited debris disadvantageously. Those parts of the deposited debris, through which the water escapes and runs towards the openings, are cleared of the fine and binding sediment, making these parts weak. If, on the contrary, the drainage-openings are built as above explained, the coarse and fine detritus mixed with silt and loam will finally form a solid firm mass. All the masonry is made with hydraulic lime. The crest of the dam is horizontal. An overflow is made at a place where the ground in front is very solid and has great resisting strength. The overflow is large enough to allow the usual amount of water to pass after the drainage openings are filled up. In case the amount of water should increase beyond the capacity of the overflow, the water will run over the entire length of the dam equally distributed, so that the strain on the apron is equal and washouts will not occur. The crest of the dam should always be horizontal crossways. It is correct to lay the layers of masonry at 90 degrees to the outer slope of the dam, but the last layers should gradually be laid horizontal. The horizontal crest is of great importance in reference to its security. If it is inclined, the shock of rocks or a floating log may destroy the upper edge, which may result in the complete destruction of the dam. The present top of this dam is inclined, as it is intended to raise the dam.

The water flowing over the crest will tend to wash out the foreground. A strong apron was made of large rocks, 33 feet wide; a row of piles has been driven along the lower edge of the apron. Pavements, boxes filled with rocks, are also used for this purpose, but are not as good; because as soon as the dam is built and commences to set, the clean water, free of sediment will begin its scouring action, and the profile of equilibrium will be formed at once. Only when the dam is filled up and the sediment is transported over its crest, a cessation of the action above mentioned is noticeable. Therefore, the protection of the ground in front of ths dam serves only to move down stream the formation of the profile of equilibrum demanded by nature. The end of the protection work must then be secured anew. This part of the structure lacks a proper support down stream and requires continuous work of maintenance. The rocks roughly

FIG. 4.

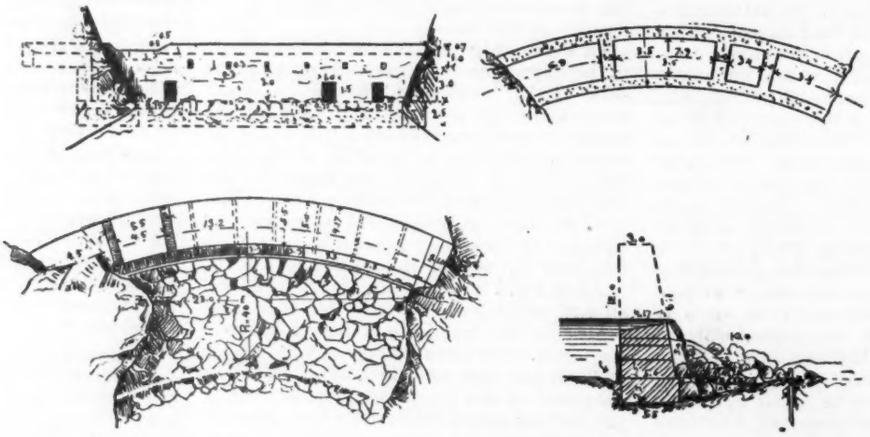

FIG. 5.

FIG. 6.

FIG. 7.

thrown in follow each wash-out by falling into it; it is the best kind of apron.

The above statements do not apply, or at least only partly, to dams calculated to secure the bottom of the torrents and rivers, in which the profile of equal action is secured from one structure to the other.

Municipal Engineering; Paper No. 2.*

PROVIDENCE, RHODE ISLAND.

(*Continued from Page 342*).

Highways.

Street Monuments.—The lines of streets in the thickly built portions of the city are usually located by offsets to corners of adjacent buildings. In other portions stone bounds are set to indicate angles or extremities of street lines. These bounds are usually of granite from 3½ to 4½ feet long with heads dressed to about 6 inches square, and with a small hole drilled in center. They are set flush with the surface, the drill hole being placed at the point to be indicated. A State law forbids the wilful removal of bounds under severe penalties, and when in grading streets it becomes necessary to raise or lower one, it is done under supervision of the city engineer's department.

Laying out New Streets, etc.—There are several forms by which a street may be laid out. It is generally done by the Board of Aldermen upon request of the City Council. When private property is taken payment is made from the city treasury. Upon petition of abutting owners streets platted by private parties and partially built upon are frequently laid out or accepted under the same form, no compensation for land damages being required.

Streets are also laid out by the City Council under what is known as the "betterment act," a portion (usually ⅔) of the damages being assessed upon the benefited estates by commissioners appointed by the Supreme Court.

Streets platted by private parties for the sale of adjoining lots frequently remain for many years unaccepted. Such streets when built upon are lighted by the city, but no repairs are undertaken and no regulation other than the posting of signs of "not a public highway."

Accepted streets are generally graded by the city, excepting those laid out upon petition of abutting owners. Before accepting a street of this kind, an estimate is made of the cost of bringing it to grade; the work is usually done by or at the expense of the abuttors.

Names of Streets.—Street names are very generally indicated by signs, which are of two kinds, viz.: cast-iron with skeleton letters, which are placed on street lantern tops to be visible at night, and painted wooden signs, the letters being black upon a white ground.

Cross-section of Streets.—The plans show sections of streets paved with granite blocks, asphalt and cobble, (See Plate 26, upper section for cobble, and lower section for asphalt,) also macadamized streets where a gutter is paved at the sides for the disposal of surface water. (Plate 26*a*.)

The granite block paving is laid in this city in three ways:

First, laid upon a bedding of sand without a foundation, except the natural surface, (see Plate 27, Fig. 1.) The sand is usually 3 or 4 inches in depth unless the natural material is such as will be affected by frost, when the same is removed and replaced by sand or gravel.

Second, laid upon a gravel, refuse or chip stone foundation; the depth is usually from 6 to 8 inches, the material being thoroughly rolled with a steam roller, the surface being left true to section and parallel with the finished surface. (See Plate 28, Fig. 1.) Sufficient sand, about 1½ inches under the average block, is used to bed the block; the joints of the paving are filled with sand.

Third, laid upon an hydraulic cement concrete foundation, the blocks bedded in sand as in the second form, (Plate 28, Fig. 2); the joints of the paving are then filled with pea gravel and asphaltic mixture. The foundation is from 5 to 7 inches in depth and the proportions vary from 1 cement, 2 sand, 6 of stone to 1 cement, 2 sand and 4 of stone, depending upon the traffic in the street; this last class or form is usually adopted in the center of the business portion of the city. There is but very little highway work done in this city by contract, consequently there are but few printed specifications.

The following is the specification used in paving Westminsier street (see Plate 27, Fig. 2), and gives a description of the last class of paving:

City Engineer's Office, Providence, R. I., 1880.

TO CONTRACTORS.

Proposals for preparing and paving with granite block pavement, Westminster street, from the west curb-line of Exchange street to the east curb-line of Jackson street, together with all other work described in the specification.

Sealed proposals for the above-mentioned work addressed to "Gilbert F. Robbins, Chairman, Joint Standing Committee of the City Council on Highways," and endorsed, "Proposals for paving Westminster street," will be received at the office of the City Engineer until—.

The person or persons to whom the contract may be awarded will be required to attend at this office with the sureties offered by him or them, and execute the contract within three days from the date of the service of a notice to that effect, and in case of failure or neglect so to do, he or they will be considered as having abandoned it, and as in fault to the city of Providence. The work will be commenced on or before —.

N. B. The prices must be written in the bid and also stated in figures, and all proposals will be considered as informal which do not contain bids for all items for which bids are called herein. Permission will not be given for the withdrawal of any bid or proposal, and the right is expressely reserved by the Joint Standing Committee of the City Council on Highways, to reject any and all bids.

Bidders are required to state in their proposals,

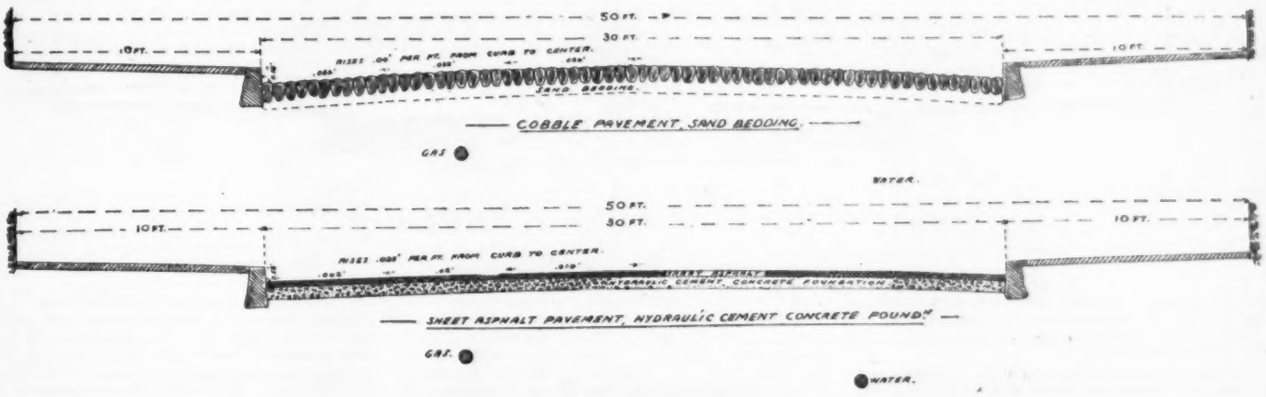

Plate 26.—Cobble and Asphalt Pavements.

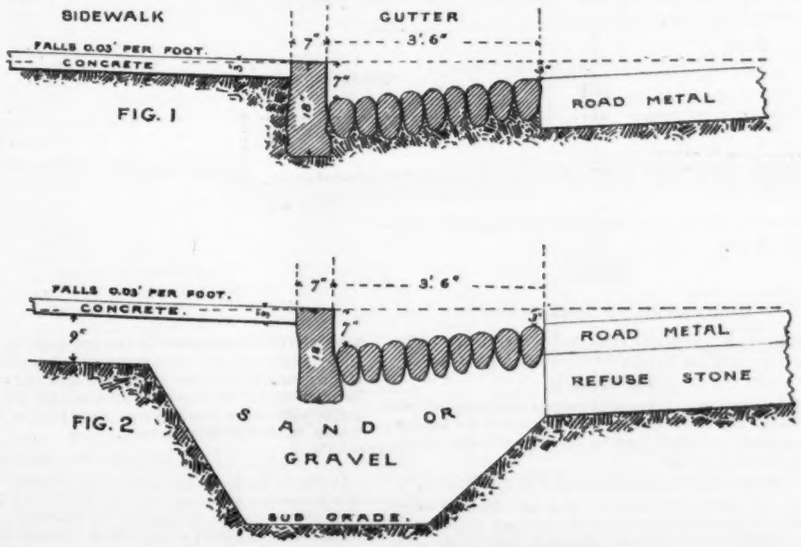

Plate 26a.—Paved Gutters on Macadamized Streets.

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their names and places of residence, the names of all persons interested with them therein, and if no other person be so interested, they shall distinctly state the fact.

Bidders will state in writing and also in figures, the price per square foot for furnishing and laying new cross-walk stone, including the sand-bed; the price per square foot for trimming and relaying such old cross-walk stone as the City Engineer may deem suitable to relay, including the sand-bed; the price per square yards for taking up and removing cobble pavement, including cross-walks, etc.; the price per cubic yard for earth excavation, including preparation of road-bed; price per cubic yard for concrete; the price per square yard for the new pavement, including sand-bed, material for joints and all necessary labor.

The time allowed to complete the whole work will be until November 1st, 1880.

The Engineer's estimate of the work to be done under the above title, by which the bids will be compared, is the taking up and removal of 7,600 square yards of cobble pavement, including cross-walks, etc.: 1,700 cubic yards of earth excavation, including preparation of road-bed; furnishing and laying 1,025 cubic yards of concrete: furnishing and placing 600 cubic yards of sand for bed; furnishing and laying 3,650 square feet of new cross-walk stone; trimming and relaying 1,004 square feet of old cross walk stone, and furnishing and laying 7,093 square yards of granite blocks, together with the necessary amount of material for joints.

All the above work is to be bid for under their heads as afore described.

These quantities are considered approximate only, and the right of increasing or diminishing the said quantities, as in his opinion may be necessary, is hereby reserved to the City Engineer.

The bond required for liquidated damages for failure to execute the contract, if awarded, is ($1,500) fifteen hundred dollars.

The bond required for faithful fulfillment of the contract is ($7,000) seven thousand dollars.

The form of agreement including the specification for the work is annexed.

GILBERT F. ROBBINS,
Chairman Joint Standing Committee, of the City Council on Highways.

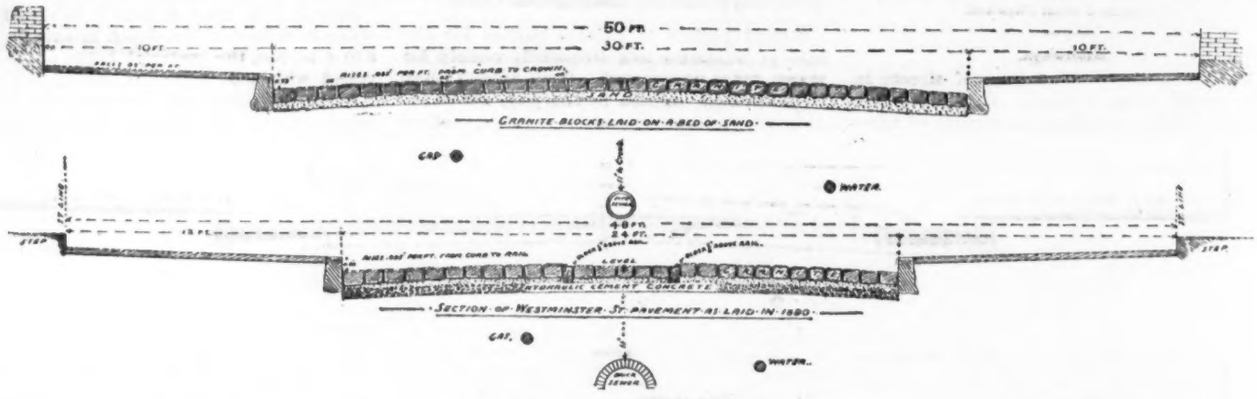


Plate 27.—Granite Block Pavements.

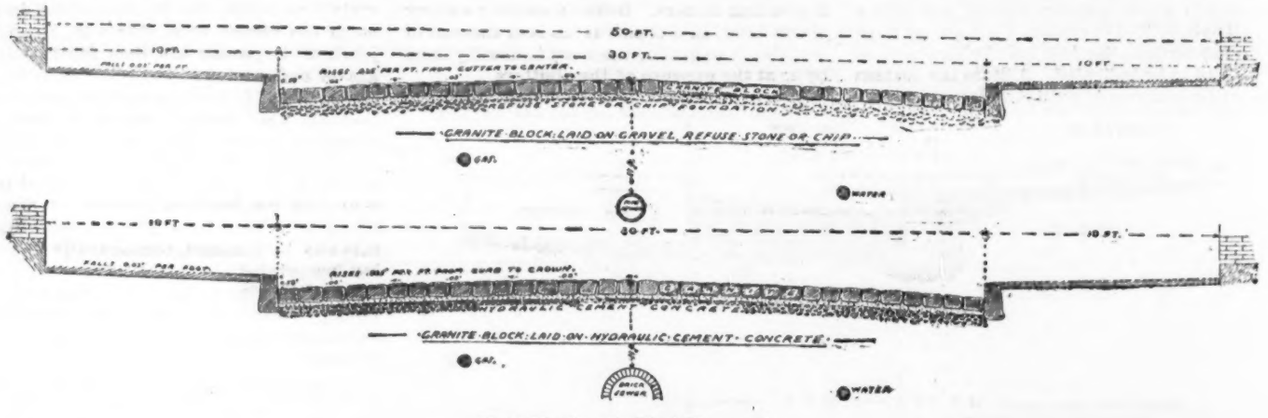


Plate 28.—Granite Block Pavements.

Form of Agreement.

To be Executed in Triplicate.

For preparing and paving, with granite block pavement, Westminster street, from the west curb line of Exchange street, to the east curb line of Jackson street, together with all other work described in the specification.

This agreement, made and entered into this day of in the year 1880, by and between the city of Providence, a Municipal Corporation created by the General Assembly of the State of Rhode Island, in the county of Providence, in said State, party of the first part: and of part of the second part.

Witnesseth, that the said part of the second part has agreed, and by these presents do for heirs, executors, administrators and assigns, covenant, promise and agree to and with the said party of the first part, for the consideration hereinafter mentioned and contained, and under the penalty expressed in a bond bearing even date with these presents and hereunto annexed, that the said part of the second part, heirs, executors, administrators or assigns, shall and will furnish and provide at own cost and expense, all the necessary materials and labor, and in a good, firm and substantial manner and strictly in accordance with the following specification do and perform all the work and furnish all the materials required therein, in preparing and paving with granite block pavement Westminster street, in said city of Providence, from the west curb line of Exchange street to the east curb line of Jackson street.

Specification.

The entire work is to be done under and in accordance with the directions of the City Engineer or his authorized agent or agents limited by the particular duties entrusted to them.

Work and Material must Agree with Specification.

All the materials furnished and all the work done, which in the opinion of the City Engineer shall not be in accordance with this specification, shall be immediately removed from the street and other materials furnished, and work done that will in the opinion of said Engineer, be in accordance therewith.

Any part or parts of the work under this agreement are to be prosecuted at and from as many different points in such part or parts of the street on the line of work, and in such a manner as the said Engineer may from time to time direct. That portion of the street not actually occupied by the contractor will be open to public travel, if in the opinion of said Engineer it shall in no way interfere with the progress and quality of the work, and no claim for damages or compensation will be made therefor by the contractor.

Right to Construct Sewers, etc., Prior to Laying of Pavement.

The right to construct side-walks, any sewer connections or receiving basins and culverts, or to build up or adjust any man-holes, or to re-set or renew any frames and heads for sewer man-holes, or for water or gas stop-cocks or pipes in said street, and to grant permits for house connections with sewers or with water or gas pipes, and to grant permission to remove the car tracks, ties, stringers, etc., at any time prior to the laying of the new pavement over the line of the same; also to enter upon, place and construct a new line of car tracks, together with all necessary ties, stringers, etc., after the concrete foundation is in place, and has been allowed thirty-six hours to set, is expressly reserved by said Engineer, and said Engineer reserves the right of suspending the work on said pavement on any part of said line of street or streets at any time during the construction of the same for the purpose above stated, or on account of failure to comply with the terms of this agreement, without other compensation to the contractor for such suspension, than extending the time for completing the work as much as it may have been delayed by such suspension; and the contractor shall not interfere with, or place any impediment in the way of any person or persons who may be engaged in the construction of such side-walks or sewer connections, or doing other work above specified, or in the construction of any receiving basin or culvert, or in setting or resetting any curb or gutter stones, or removing or constructing any car tracks, on the line of the street.

Quality and Dimensions of Stone Blocks.

The stone blocks for the pavement are to be of granite of a durable, sound and uniform quality, not liable to wear slippery, each measuring on the face or upper surface not less than 8 or more than 10 inches in length (the whole to average not more than 9 inches), not less than 3 nor more than 4 inches in width, not less than 7 nor more than 8 inches in depth, to be split and dressed so as to form, when laid, end and side joints not exceeding 1 inch wide, top or bottom with fair and true surfaces on top and bottom. They will be carefully inspected after they are brought on the line of the work, and all blocks which in quality or dimensions do not conform strictly to these specifications will be rejected and must be immediately removed from the line of the work.

To be Carefully Culled.

The contractor will be required to furnish such

laborers as may be necessary to aid the inspector in the examination and culling of the blocks, and in case the contractor shall neglect or refuse so to do, such laborers, as in the opinion of the City Engineer, may be necessary will be employed by said Engineer, and the expense thus incurred by him will be deducted and paid out of any money then due or which may thereafter become due to the said contractor under this agreement.

The blocks will be inspected for size by templet measurement if deemed advisable by the City Engineer.

Over Rail Ties and Other Places.

Between, in, and 1 1 and ½ feet outside of railroad tracks, around sewers, man-hole frames and in such other places as the Engineer may deem proper, the contractor shall use stone blocks of such lesser dimensions as the Engineer shall direct.

Cross-Walk Stones.

Where new cross-walk stones are required they are to be furnished in conformity with the following description, to wit:—

The stones furnished for cross-walks shall be of granite, tough and hard, of a uniform texture; they shall be not less than 3 feet in length, of a uniform width of 24 inches and not less than 8 inches in depth, with good square edges and ends so as to make joints of not more than ⅛ inch when laid; the top surface to be reduced to within ⅛ of an inch of a true plane; the stone set within the railroad track shall be of a length equal to the distance between the rails.

The cross-walk stones will be carefully inspected after they are brought on the line of the work, and all those which in quality and dimensions do not conform strictly to these specifications, will be rejected and must be immediately removed from the line of the work.

When required by the Engineer, old cross-walk stones will be re-laid, conforming to this specification as closely as possible.

The city of Providence will re-set necessary portions of the curb lying between Exchange and Dorrance streets, bringing the same to the established grade, and will set circular curb-stones at various intersecting curb lines; said city will also raise or lower all man-hole covers, gate-box covers, catch-basins, etc., to conform to the grade of the new pavement.

Contractor to Maintain Stakes, Curb-Stones, etc.

The contractor will furnish assistance for setting, and will maintain all grade stakes. He will also maintain all curb-stones, side-walks, man hole frames, gate-boxes, catch-basins, water and gas-stops, car-tracks, ties and stringers in position during the progress of the work at his own cost, and should he fail to so maintain such parts in place, will re-set and repair the same to proper line and grade, at his own expense.

Materials Inspected.

On the day designated by the said Engineer for the commencement of the work at any point or points on the line thereof, the said contractor shall, before disturbing or making any alterations in the present roadway, haul upon the line of the work a sufficient quantity of stone blocks, cross-walk stones, and all other material necessary for the paving of at least the space between any two intersecting streets, and more if required by the Engineer, and give notice to said Engineer when he will commence to deliver stone on any street or streets.

Rejected Material Forthwith Removed.

The stones or other material so brought upon the ground and before they are laid, will be carefully and thoroughly inspected, as provided for in this specification, and all rejected material shall be immediately removed by the contractor from the line of the work. The contractor will not be allowed to pile any material within 3 feet of any fire hydrant, or within 6 inches of any water or gas stop, or in such manner as will interfere with passage-way on the line of the side-walk, or prevent free access from the roadway to each house on the line of the street.

After this inspection has been made, and after all the rejected stones shall have been removed entirely from the line of the work, and the accepted stones or other material piled in the manner aforesaid, and not until each of these conditions shall have been faithfully fulfilled, will the contractor be permitted to proceed with the preparation of the road-bed for the new pavement.

It being expressly understood that the work is to be prosecuted in sections of not less than the space between any two intersecting streets, if so directed by the Engineer, and that these provisions relative to the hauling, inspection, removal and piling of materials, shall apply to the work on each of said sections on the line of the street.

Removal of Present Pavement and Preparation of Road-bed.

The present pavement, including all cross-walk stone rejected by said Engineer as unfit for further use, shall be taken up and delivered at the City Yard (so called) satisfactory to the City Engineer.

The sub-soil or other matter shall then be excavated to such a depth as that, when the surface has been thoroughly compacted by ramming or rolling (as shall be done), it shall be left 14½ inches below the grade of the top line of finished pavement, except the cross-walks at intersecting streets, where the excavation after ramming, etc., shall be 13 inches below the top line of walk. Should there be any material of such a nature that it cannot be compacted satisfactory to the Engineer, such material shall be removed to a depth of not less than 2 feet, and the space filled with gravel or sand, thoroughly rammed.

All holes and inequalities shall be likewise filled.

No ploughing will be allowed in preparing the foundation.

Concrete Foundation.

Upon the foundation thus prepared, except under the cross-walks at intersecting streets shall be placed a bed of concrete 5 inches in depth. At Dorrance street, and where vaults, railroad ti s, sewer connections, etc., are encountered, the depth of concrete will be increased or diminished, as the Engineer may deem necessary.

Sand Bed.

On this concrete foundation shall be laid a bed of clean, sharp sand, perfectly free from moisture (made so by artificial heat if deemed necessary by the Engineer) not less than 1½ inches thick, to the depth necessary to bring the pavement to the proper grade when thoroughly rammed.

Laying the Blocks and Filling of Joints.

Upon this bed of sand the granite blocks (and walks crossing Westminster street) will be laid. The blocks will be laid at right angles to the line of the street and intersecting streets. They will be placed as close as possible to one another, forming joints not more than 1 inch in width, top and bottom; each course to be formed of blocks of uniform width, and depth, and so laid that all longitudinal joints shall be broken by a lap of at least 2 inches. When thus laid the blocks shall be immediately covered with clean, hard, dry gravel, artificially dried if deemed necessary by the Engineer. This gravel shall be free from sand, it shall be such as has passed through a sieve of three quarters of an inch mesh and retained by a quarter inch mesh. It shall be brushed into joints. The blocks are then to be carefully rammed. More gravel shall then be brushed in to fill the joints, the blocks again carefully rammed; the process to be repeated until the joints are full, and the blocks brought to an unyielding bearing, with uniform surface, true to the crown of the roadway as given by the Engineer.

There will then be poured into the joints, in a boiling state, an asphaltum mixture, composed of coal-tar pitch and creosote oil, in the proportions of fifty gallons of oil to one ton of pitch; these are to be melted together in iron boilers holding not less than 2,500 pounds. It will be poured into the joints of the pavement until the sand beneath and the gravel between the blocks will absorb no more and the joints are filled, flush with the upper surface of the pavement.

Material to be kept Dry.

The stone for the pavement, the sand for the bed and the gravel for the joints shall each and severally be laid only when dry and free from moisture. After being laid, the contractor shall protect them from the weather until the joints have been filled with said asphaltum mixture, and should they become moist from any cause before filling the joints with said mixture, the contractor shall at his own expense remove that portion of the work so moistened, and replace and complete the same with dry materials.

The contractor shall in each and every case so protect the work when unfinished, as to prevent water from entering between the stone blocks and the concrete foundation.

The blocks to be laid next to the railroad stringers shall be selected as free from bunches as possible, and laid as close against the timber as can be done.

The contractor will, at his own expense, dress or trim off all bunches from the curb-stone which may in any way prevent the proper laying of the stone blocks or forming the joint of the same.

Concrete.

The concrete shall be composed of one part of fresh ground American hydraulic cement, of the best quality, two parts of clean, sharp sand, and six parts of broken or screened stone.

All cement furnished by the contractor will be subject to inspection and test before it is used, and shall when mixed be capable of resisting a tensile strain of fifty pounds per square inch, after thirty minutes exposure in air and twenty-four hours immersion in water.

The contractor will be required to furnish the engineer or inspector full facilities for examining and testing all cement to be used, and the Engineer is to decide upon the character and severity of the test to be applied; and all cement, which in his opinion is of improper or inferior quality, must be immediately removed from the work. When cement is accepted, if not immediately used; it must be protected from the weather and kept dry, and in no case will it be allowed to be placed upon the ground without blocking under the barrels.

The broken or screened stone to be sound and solid, free from dust and dirt, and of a size not larger in any dimension than will pass through a two-inch ring.

The cement and sand is to be made into mortar in boxes if required, and the broken or screened stone, which shall be sprinkled so as to wet the surface of the stone, shall then be added and the whole shall then be quickly and thoroughly mixed until every stone is coated with mortar.

The concrete thus made shall then be placed in proper position and there rammed until it is thoroughly compacted and has a clear mortar surface, which surface, when left, shall be nine and one-half inches below the grade of the top of the finished pavement.

The surface shall be kept wet, if required, until covered with sand. At least thirty-six hours shall be allowed for the concrete to set before the pavement is laid. When connection is to be made with any layer, set or partially set, the edge of such layer must be broken down and shall be free from dirt and properly wet so as to make the joint fresh and close.

No driving on the concrete-bed will be allowed. The sand is to be placed on the concrete from wheel-barrows.

No allowance in measurement will be made for any concrete which may be driven into the earth by ramming below the grades given for the sub-foundation.

Laying Cross-Walks.

The cross-walks across the line of the new pavement and at intersecting streets are to be laid, where required, with new cross-walk stones, or the present cross-walk stones shall be re-laid as the said Engineer may direct, in which last case they shall be dressed or re-dressed, so as to form one-half of an inch joints from top to bottom when laid. All cross-walk stone, whether new or old, shall be fitted close to the curbing; where required, gutters shall be chiselled out nearly to a depth to correspond with the paving at the curbing and a width of 15 inches at the top of the stone so as to make a proper opening for the escape of water. The walks crossing Westminster street will be laid in the same manner as the stone-blocks, excepting the joints shall not exceed one half-inch.

All other new cross-walk stones and such of the present cross-walk stones as may be retained, excepting those crossing Westminster street, are to be set in a bedding of clean sharp sand not less than 6 inches in depth, to be set and tamped in such a manner that they shall admit of no further settlement; they will be true to the line and grade as given by the Engineer, making joints not over ½ inch wide from top to bottom on sides and ends; the joints to be filled with sand. All cross-walk stone is to be laid in courses so as to break joints by a lap of at least 1 foot, except at the railroad tracks.

Cleaning Up.

All surplus material, earth, sand, rubbish and refuse stones are to be removed from the line of the work as rapidly as the work progresses, and unless this be done within twenty-four hours next thereafter, to the satisfaction of the Engineer, the work will not be considered as completed according to this agreement, and the right is hereby expressely reserved to the City Engineer to proceed to employ the necessary men and teams and to do said work at the expense of the contractor.

It is agreed by said contractor that two days after any section of the pavement is laid and joints filled, if in the opinion of the City Engineer it shall be proper, the street will be opened to public travel, and that said contractor will keep all work which may be done by him in proper repair, until the entire work herein specified shall have been completed and accepted by the City Engineer, without any claims being made on the part of the contractor.

It is further agreed that all loss or damage arising out of the nature of the work to be done under this agreement, or from any unforseen obstructions or difficulties which may be encountered in the prosecution of the same, or from the action of the elements, or from incumbrances on the line of the work, shall be sustained by the said contractor.

Engineer, Contractor, etc.

Whenever the word "Engineer" is used herein it shall be understood to refer to the City Engineer of the city of Providence.

Whenever the word "Contractor," or the words "party of the second part," or the pronouns in place thereof are used herein, they are to be considered as referring to and meaning the party or parties, as the case may be, of the second part to this agreement.

Approximate Estimates.

Approximate estimates will be made monthly by the Engineer, on or before the tenth day of each month

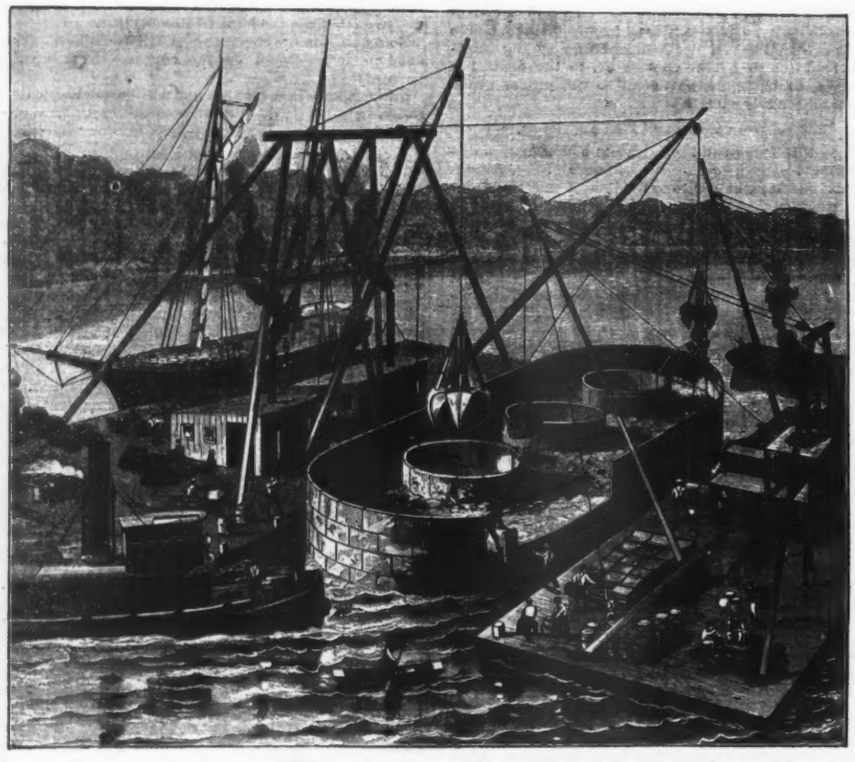
for the work done during the preceding month. Eighty-five per cent. of which will be due and payable on or before the fifteenth day of said month.

It is expressely understood that such estimates shall only be made when the work progresses as rapidly as may be required by said Engineer and in accordance with the provisions of this contract.

It is further mutually agreed that whenever this contract, in the opinion of the City Engineer, shall be completely performed on the part of the contractor, the Engineer shall proceed with all reasonable diligence to measure up the work and shall make out the final estimates for the same and shall certify the same to the Joint Standing Committee of the City Council on Highways, when said sum shall be due and payable to the contractor.

Work to Commence.

The said party of the second part hereby further agrees that he will commence the aforesaid work on or before at such point or points as the City Engineer may designate, and fully complete the re-pavement of Westminster street, in the manner in this agreement set forth and described, on or before;



Pier Sinking at Hawkesbury Bridge, So. Australia.

that he will employ a suitable superintendent or foreman to represent him on the work in times of his absence, with power to act; that he will employ only competent persons, skilled and experienced in the several parts given them to do; that he will give his personal attention constantly to the faithful prosecution of the said work; that he will not sublet the aforesaid work or any part thereof without the previous written consent of the City Engineer, endorsed on this agreement, but will keep the same under his own control; that he will not assign, by power of attorney or otherwise, any of the moneys payable under this agreement, unless by and with the previous consent of the said Engineer, to be signified by endorsement on this agreement.

If at any time any overseer or workman employed by the contractor shall be declared by the Engineer to be unfaithful, incompetent or disorderly, the contractor on receiving notice shall forthwith dismiss such person and shall not again employ him on any part of the work.

The said party of the second part further agrees that if at any time the City Engineer shall be of opinion, and shall so certify in writing, that the said work or any part thereof is unnecessarily delayed, or that the said contractor is wilfully violating any of the conditions or covenants of the contract, or is executing the same in bad faith, or fails to prosecute the same with such dispatch as in the opinion of said Engineer is necessary to complete it within the time specified, he shall have the power to notify the aforesaid contractor to discontinue all work or any part thereof under this contract, and thereupon the said contractor shall discontinue said work or such part thereof, and the City Engineer shall thereupon have the power to place such and so many persons as he may deem advisable, by contract or otherwise, to work at and complete the work herein described, or such part thereof, and to use such materials, tools or appliances as he may find upon the line of said work, and to procure other materials for the completion of the same, and to charge the expense of said labor and materials to the aforesaid contractor; and the expense so charged shall be deducted and paid by the party of the first part out of such moneys as may be then due, or may at any time thereafter grow due to the said contractor under and by virtue of this agreement, or any part thereof; and in case such expense is less than the sum which would have been payable under this contract, if the same had been completed by said contractor, he shall be entitled to receive the difference; and in case such expense shall exceed the last said sum, he will pay the amount of such excess to the parties of the first part, on notice from the said Engineer so to do.

And it is further agreed that the contractor shall not be entitled to demand or receive payment for any work upon, in, or about the said work as extra work, unless ordered in writing by the City Engineer to do the same as extra work, and a price therefor shall be agreed upon in writing previous to its commencement.

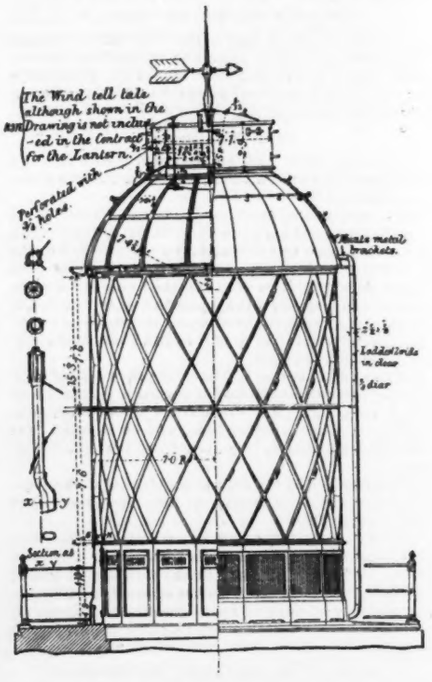
And the said party of the second part further agrees that during the performance of said work he will place proper guards upon and around the same for the prevention of accidents and at night will put up and keep suitable and sufficient lights, and that he will indemnify and save harmless the parties of the first part from all suits and actions of every name and description brought against them, and all costs and damages to which they may be put, for or on account or by reason of any injury or alleged injury to the person or property of another, resulting from negligence or carelessness in the performance of the work, or in guarding the same, or from any improper materials used in prosecution, or by or on account of any act or omission of the said party of the second part or his agents; and the said party of the second part hereby further agrees that the whole or so much of the moneys due to him under and by virtue of this agreement as shall or may be considered necessary by the city of Providence, shall or may be retained by the said parties of the first part until all such suits or claims for damages as aforesaid shall have been settled, and evidence to that effect furnished to the satisfaction of the said city.

(TO BE CONTINUED.)

WOODBURY, N.Y.—New gas works are to be erected at a cost of $30,000. Dr. W. C. Clark, President; Charles W. Star, Treasurer.

Lighthouse Lantern.

Herewith and on page 359 we give engravings of two 14 feet lanterns designed by Sir J. Douglass for the lighthouses on Bishop's Rock and Round Island. These engravings are so fully dimensioned and described that it is not


The Wind tell tale although shown in the Drawing is not includ-ed in the Contract for the Lantern.
Perforated with ⅜ holes
Bronze metal brackets.
Inlet slits in door
⅜ diar
Section as x y

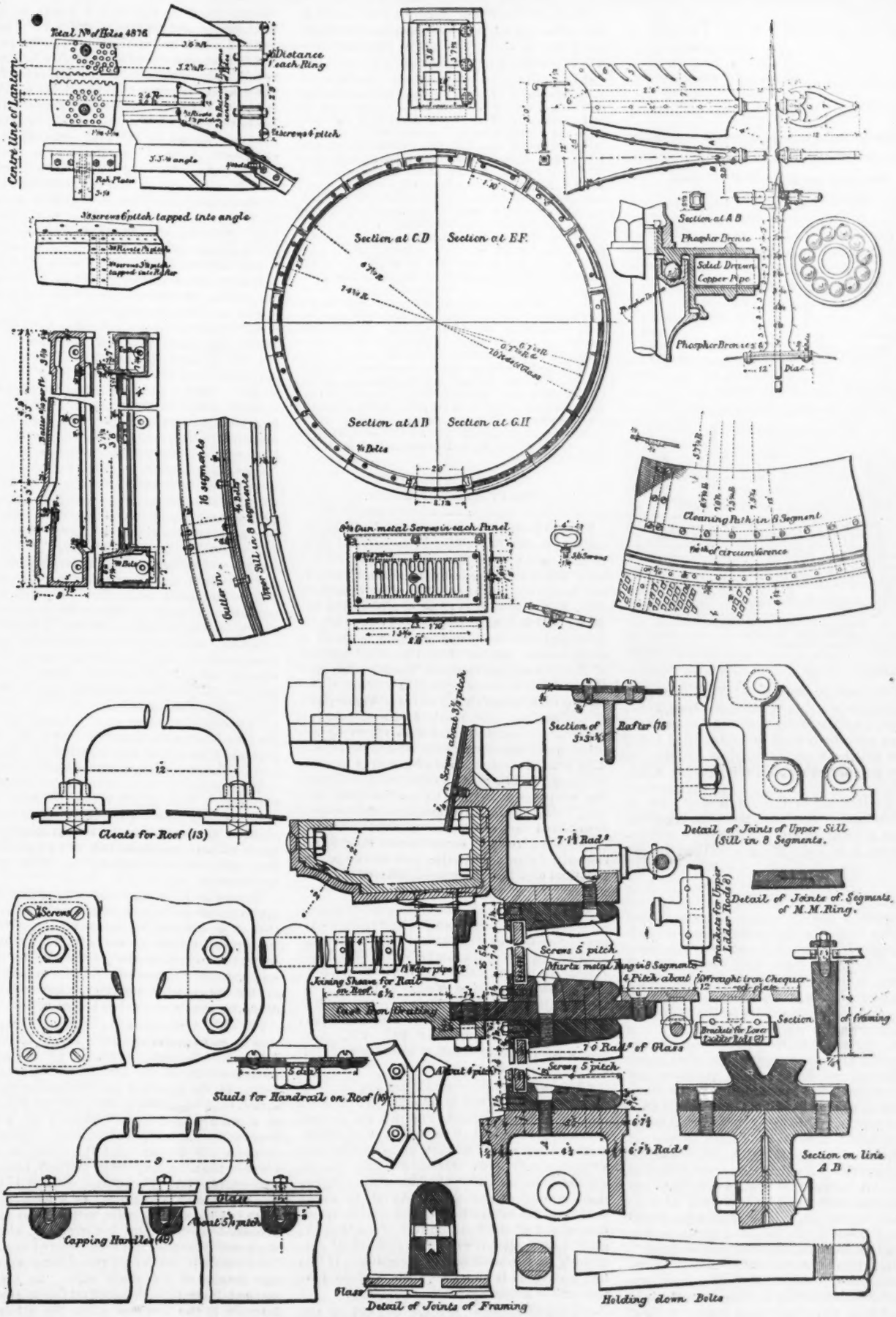
necessary to say much about them here. The engraving annexed is an external general view of the lantern, which is made largely of phosphor bronze. The various details will be readily made out by comparing the engraving on page 359 with that given above, and which we reproduce from the London *Engineer*.

An Unstretching Chain.

Each link is of hard tempered steel, and fluted to increase its strength. The long links are connected by two dove-tailed steel rings which cannot open or stretch, and one central solid steel ring, as shown. This arrangement is applicable to other purposes than the measuring chain.—*Cassells Family Magazine for May.*

WE reproduce from the *Scientific American* an illustration of the method of sinking the piers for the Hawkesbury Bridge, New South Wales, by Messrs. Anderson and Barr subcontractors under the Union Bridge Company, New York city.

BATON ROUGE, LA., May 20.—In the Senate to-day Mr. Breaux introduced an act entitled "An act to incorporate the City of New Orleans, and to provide for the Government and administration of the affairs thereof; and to provide a method for the draining and paving of New Orleans." This act defines the powers of the City Council. The Commissioner of Public Works shall have general charge of all matters relating to water-works, railroads, levees, weights and measures, the fire department and manufactures, cleaning and repairing the streets, sidewalks and wharves, etc., and to receive a salary of $3,500 per year. He is to give a bond of $25,000. A surveyor is to be elected for four years at a salary of $2,500. It provides for draining, paving and land reclamation, and making any other public improvements.


Section at C.D
Section at E.F
Section at A.B
Section at G.H
Section at A B
Phosphor Bronze
Solid Drawn Copper Pipe
Cleaning Path in 8 Segment
Gutter in 16 segments
Upper Sill in 8 segments
Cleats for Roof (13)
Detail of Joints of Upper Sill (Sill in 8 Segments.
Detail of Joints of Segments of M.M.Ring.
Joining Sleeve for Rail on Roof.
Studs for Handrail on Roof (16)
Capping Handles (48)
Section of Framing
Section on line A B.
Detail of Joints of Framing
Holding down Bolts

LIGHTHOUSE LANTERN, BISHOP'S ROCK.
(From London *Engineer*.)

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TABLE OF CONTENTS.

	PAGE
The Wetzmann Retaining Dam (*Illustrated*)	353
Municipal Engineering (*Illustrated*)	355
Lighthouse Lantern (*Illustrated*)	358
Editorial Notes	360
The Prismoidal Formula	360
Government Ownership of English Railroads	361
Personal	361
American Society of Civil Engineers	361-362
The Connecticut Association of Civil Engineers	362
Liverpool Engineering Society	362
Short-cuts and Approximations	362
Correspondence	363
River and Harbor Improvements	363
Review of the Foreign Engineering and Industrial Press	363
Another Home-made Testing Machine (*Illustrated*)	364
Water	364
News of the Week	366
Stations of Coast Survey Vessels	368
Street Accidents in Paris	368
Market Report	368

THE Rensselaer Society of Engineers will hold a Public Meeting at Harmony Hall, TROY, N. Y., on Tuesday, June 15th, at 8 o'clock P. M., when an address by Francis Collingwood, C. E., will be delivered on the pertinent subject of "Some Often Neglected Duties of the Engineer."

At the Meeting of the Engineers' Club of Philadelphia, on May 15th, Mr. E. S. Hutchinson read a paper giving a Résumé of the Report of the Hon. John Bigelow on the Panama Canal.

MESSRS. WM. DENNY & BROTHERS, the Clyde ship builders, having occasion lately to revise their rules for the government of their yards called in their workman and discussed the proposed new rules with them. One of the men, a joiner, proposed that the fines should be graded in proportion to the ability to pay; that there should not be the same fine for a laborer as for a journeyman.

It was decided that the children of the workmen should be first employed, the girls going into the art, upholstering and polishing department; that the masters should be fined with the men, and that both the men's fines and the master's equivalent should go into the accident fund: also that the fines should not be varied according to impulse, "but according to general principles that could be admitted as just," it being held that, as civilised nations are not now ruled by laws they have no influence in making, neither should the workmen of a great works be ruled by laws they have had no voice in preparing and making.

Messrs. Denny & Brothers it will be remembered, lately offered their men premiums for improvements either in tools or methods of manufacture; while they may have "a right to manage their own business their own way," they apparently see a profit in the other plan.

WE wish to add our hearty endorsement to the following editorial comment of the Baltimore *Sun* on the letter of Col. Craighill elsewhere reprinted in this journal:

The observations made by Col. Wm. P. Craighill, of the engineer corps of the army upon the undiscriminating character of much of the criticism indulged in by the press of some sections of the country in regard to river and harbor bills, are eminently just. It is perfectly true, as he says, that this criticism seldom goes into details. Bills are abused in lump without attention to the merit of many or perhaps most of their items. "No bill," Col. Craighill justly remarks, "on any subject containing many items is going to be free from objections so long as men are legislators and so many diverse interests are to be considered." It is unreasonable to exact of this kind of a bill the perfection that is not required in others. As a matter of fact he holds that "if river and harbor bills be analysed, the percentage of improper items will generally be found very small." Much is said of "mud-puddles" and "trout streams" without definite knowledge, and with the practical result that navigable streams which need but a little care to become valuable avenues of commerce continue to be neglected. Proper objection can be made only to bills made up in the interest of politicians on the log-rolling principle, the effect of which is to stint rivers and harbors really susceptible of improvement in order to spread the appropriation over the creeks and marshes of the greatest possible number of districts. This is legislation neither for the "regulation of commerce" nor for the "general welfare," but for the taxation of commerce for the welfare of the individuals.

The Prismoidal Formula.

The subject of the proper method of computing the amount of earthwork in railroad excavations and embankments, is one which has been much discussed by engineers, both in text-books and in the columns of techinal journals. For some reason there is a powerful tendency which leads authors and engineers to favor and use certain approximate methods of computation, rather than the strict method of the prismoidal formula. They realize that these methods are incorrect in principle, and that in many cases they give results materially deviating from the truth; and accordingly a correction is often devised which is to be applied to produce the proper numerical values. This plan of applying a correction to an erroneous method in order to arrive at the truth has always seemed to us an illogical one. For, if the prismoidal formula gives the correct result, and the erroneous method plus the correction gives the same result, then it necessarily follows that the two methods are identical and but different forms of one formula.

We have been moved to make some remarks on this question in consequence of the appearance of an editorial article on earthwork computation in the last number of the *Railroad Gazette*, in which much reference is made to those methods of computation which we have termed illogical. Our views on the subject have been set forth at various times, and particularly in an editorial in Vol. VII, page 255, of ENGINEERING NEWS, from which the following is quoted:

"The prismoidal formula then applies, and no other formula not identical with it does apply. A method founded on this has no tendency to give results either in excess or defect, and all other methods have more or less such a tendency." This statement may be regarded as an axiom or fundamental proposition, which ought to be placed by every author at the beginning of his discussion of the subject of the computation of earthwork, after having shown what the prismoidal formula is, and to what solids it applies. If this had been done in the past such confusion as now exists might have been avoided.

Our contemporary invokes the aid of the theory of probability, to show that accurate methods of computation are preferable to erroneous ones. This, we think, needs no proof, but must be self-evident to all. An accurate method which has no tendency to give results either in excess or defect, can give erroneous results only by reason of the imperfection of the data or by reason of errors in computation. As such imperfections and errors are as likely to be positive as negative, the aggregate result must be the best obtainable. An erroneous method, which gives a *constant error* of one cubic yard always in the same direction, gives a total error of 1,000 cubic yards in the aggregate of 1,000 solids. This constant error due to the method, is a very different thing from the probable error, or uncertainty, of the result obtained by the exact method. A probable error is as liable to be positive as negative, and is a measure of the precision of the result. We cannot agree with the reasoning of our contemporary when it compares the "probable error of one cubic yard, always in one direction," with the probable error of the correct method, since the first is not a probable error at all, but a constant excess or defect. The conclusions that tendency to error in either direction must be eliminated, is certainly most true, and this according to our thesis above quoted can only be done by a proper use of the prismoidal formula.

Given a prismoid bounded by two parallel plane ends; its solidity is obtained by adding together the two end areas and four times the area of a section of the prismoid halfway between the two ends. and then multiplying this sum by one-sixth of the length. This is the simple prismoidal formula, applicable not only to right cylinders and prisms, to cones and to pyramids, to hyperbolic paraboloids, but also to spheres, ellipsoids, paraboloids of revolution, hyperboloids, and in fact to all prismoids bounded by surfaces which can be generated by straight lines or curves of the second order. Not merely a useful practical rule, but a marvelous mathematical theorem is this prismoidal formula.

To use this for earthwork calculations it is first necessary to compute the end areas. This is always easy, but not so with the middle area. Herein lies the reason why authors and engineers favor the approximate erroneous methods. The middle area is often difficult to compute, and it is regarded as cheaper to use the method of averaging end areas with its constant error in excess, rather than carry out the computations of the accurate formula.

There can be no objection to the use of an approximate method of computation, *provided* that it is cheaper to incur the errors therefrom resulting than to make the longer calculations required by the prismoidal formula, and *provided* further that he who uses the approximate method clearly recognizes it as liable to a constant error in one direction.

The only true basis for a precise computation of earthwork quantities seems to be the prismoidal formula, preceded by the actual measurement of the middle sections in the field. If the stations are uniformly 100 feet apart, each alternate section may be regarded as a middle area for a prismoid 200 feet in length; here the application of the prismoidal formula will be easy and the result be more correct than by any other method using the same data. But if a shorter method is to be employed let it be regarded as a modification of the prismoidal formula, rather than an approximate method plus a correction which is supposed to render the result more exact.

To conclude, we repeat the closing words of our article of six years ago: "As for the method, it ought to be based on the prismoidal formula if the finances allow the attendant labor; if not, it must be chosen according to the allowable expense for office work, keeping

always as near to the prismoidal rule as possible. The constant conflict about the best methods is, in reality, a conflict between accuracy on the one hand and expense on the other, and as the proper balancing of these is largely a question of judgment, it ought to be expected that the subject will be continually discussed and rediscussed by railroad engineers."

Government Ownership of English Railroads.

A late number of the New York *Tribune* has a long cablegram from London describing a paper prepared by Mr. Charles Waring "one of the best known railway contractors in England," advocating the purchase of the English railroads by Government. According to the *Tribune*, Mr. Mundella's "Railway and Canal Traffic Bill" is "simply a preliminary feeler to the agitation of this stupendous measure." It is, however, possible that the agitation of this stupendous measure is simply an effort of the railroad companies to save and perpetuate their rather large dividends. The whole tone of the debate on the second reading of the Bill showed that the "traders," as opposed to the railways, were both in earnest and in force, and there seems but little doubt that something very much like Mr. Mundella's bill, which is also largely Mr. Stanhope's bill, as it was nearly perfected before Gladstone came into power, will be passed unless a different direction can be given to the current of legislative thought.

The long settled policy in England of carefully protecting all invested capital, coupled with the very heavy representation that the railways have in Parliament, makes it possible that there will be a still further departure from the teachings of the *laissez faire* school, and that the roads may, in the language of the country, "be taken over as going concerns."

Mr. Walter points out that the capital of the roads amounts to £801,464,347, of which all except £58,600,298 pays interest, much of it far above the government rate, and that the canal stock, according to the *Tribune*, not owned by the railroad companies, is about £100,000,000, making in round numbers about £1,000,000,000.

English freight rates, as our readers know, are very high. Mr. Dorsey, in his paper read before the American Society of Civil Engineers, puts them at two cents per ton mile, and though an abstract of his paper was published in *Engineering* last year, none of his figures have been questioned; in fact Mr. Jeans, the secretary of the Iron and Steel Institute, puts the average freight rate still higher than Dorsey does, and Mr. Mundella in the debate on the second reading of his bill instanced a charge of 26s. 8d. per ton on indigo for thirty-six miles or at the rate of 17⅞ cents per ton mile. The roads, however, have not only paid something like blackmail for right of way but have also expended large sums for Parliamentary expenses, and object to any revision of their rates by a commission as *confiscation*; the traders on the other hand claim that the exorbitant railroad rates interfere with the export of their commodities. To the average American mind it would appear that the simplest way is to cheapen the process by which new and competing roads obtain power to build, but which is not the English plan, and it is proposed to have the people of England pay to the railways and their stockholders £1,000,000,000,so that in that land of cheap material and cheaper labor they can have their freights carried approximately as cheap as we have ours carried.

It is doubtful if the employés of the government will conduct the traffic of the roads with more economy than the agents of the present owners, and as the roads will not be sold for *less* than their market value, it is difficult to see where the ultimate economy will come in, though government will doubtless immediately lower freight rates, and by so doing encourage increased traffic.

PERSONAL

U. S. Lutz, formerly associated with the South Penna. R. R. and lately Assistant Road Master of the West Shore R. R., having resigned his position to open up an office for general engineering, contracting and architecture at 427 Walnut st. Phila., Pa. solicits the assistance and co-operation of his friends and professional associates. He will be glad to hear from all of them.

W. J. Sherman has been appointed Assistant Chief Engineer of the Gulf, Colorado and Santa Fé Railway, and will have immediate charge of the construction of extensions in Texas and the Indian Territory.

American Society of Civil Engineers.

The Annual Convention of this society will be held at Denver, Colorado, July 2d, 3d and 5th, 1886. Sessions for professional discussion, and one for the transaction of business will be held. After the close of the Convention railway excursions will be made to a number of points of engineering interest in Colorado. The details of these excursions will be announced hereafter. They will probably include Greely and the valuable lands reclaimed by irrigation in its vicinity, Georgetown, Leadville, Gunnison and Pueblo. The excursions will probably terminate at Colorado Springs or Manitou, and the party start thence on its return East.

Arrangements have been made with the railway lines for hauling a train for the transportation from the east of the members of the society, their ladies, and a few invited guests. It is intended by the committee to charter for the purpose a sufficient number of sleeping cars to accommodate the whole party. These cars are to be retained for the round trip. This train will start form New York on the New York Central and Hudson River Railway on Tuesday, June 29th, at 10 A. M. sharp, from the Grand Central Depot, and proceed via the New York Central and Hudson River R. R. and the Lake Shore and Michigan Southern R. R. to Chicago; thence to Denver via the Chicago, Burlington and Quincy R. R. Members from Philadelphia, Baltimore, Washington and intermediate points can probably best be accommodated by joining this train at New York. Members from Boston join the train at New York or Albany. Arrangements will be made for members from Pittsburg to join the train at Cleveland. It is not possible to state exactly the cost to each person until sufficient replies to this circular have been received to enable the committee to determine with some accuracy the number of passengers on the train. If however, the indications as to this number so far received prove correct the price will be not far from $60 for the round trip from New York to Denver and return. This will include transportation and one berth in a sleeper. Arrangements are in progress which the committee think will give satisfaction as to meals to be served on the train. This price will cover the round trip from New York and Albany, and the price will be equitably less from Buffalo, Pittsburgh, Cleveland, Toledo, Cincinnati, Louisville, Chicago and St. Louis.

Should the proposed attendance warrant it, arrangements will be also made for a special sleeper to leave Cincinnati and Louisville for St. Louis; the special cars thence will connect at some convenient point with the special train.

All information practicable as to these and other points will be sent directly to members notifying the committee of their intention to attend the Convention.

The committee will assign berths on the special cars as orders for them are received, and the necessary financial arrangements will require a remittance of $20 with the order for each berth. See form enclosed

Programmes will be issued directly. The president of the society, Henry Flad, Esq., will deliver the annual address at one of the sessions of the Convention.

Members are requested to transmit to the secretary the papers they are willing to present in order that a place may be given them in the programme. The families of members are invited to accompany them to the Convention.

In order that the arrangements for transportation to and for accommodation at Denver may be perfected *it is necessary that the information covered by replies on inclosed blanks be sent to the committee at once.* Reply at your earliest convenience.

William R. Hutton,
William H. Wiley,
Robert B. Stanton,
A. M. Wellington,
John Bogart,
Committee.

New York, May 25th, 1886.

The titles of papers published in Transactions since the last Convention, or in preparation for publication, and upon which discussion is invited, are given below.

Members are paricularly desired to take part in discussion upon any of the subjects presented, either by these papers of the past year or by new papers. Members are also requested to present papers upon other subjects.

PAPERS PUBLISHED DURING THE PAST YEAR:

302. (May, 1885.) The Problem of Submerged Weir: Clemens Herschel.
303. Structural Steel: Edward B. Dorsey.
304. Electrical Transmission from Niagara: Benjamin Rhodes.
305. (May.) Harbor Works at Copenhagen: H. C. V. Moller.
306. (May.) Discussion on Levee Theory Tested by Facts: J. A. Ockerson.
308. (June.) Description of some Experiments made on the Providence R. I., Water Works, to ascertain the Force of Water Ram in Pipes: Edward B. Weston.
309. (July.) The Preservation of Timber: Report of the Committee.
310. (August.) The Preservation of Timber: Appendices to the Report of the Committee.
311. (September.) The Preservation of Forests: F. Collingwood.
312. (September.) The Preservation of Timber: Discussions on the Report of the Committee.
313. (October.) New Method of Making Conventional Signs on Original Topographical Maps: J. A Ockerson.
314. (October.) Power Brakes for Freight Trains: William P. Shinn.
315. (November.) Report of the Committee on a Uniform System for Tests of Cement.
316. (November.) Behavior of Cement Mortars under various contingencies of use: F. Collingwood.
317. (November and December.) The Cantilever Bridge at Niagara Falls: C. C. Schneider—with Discussion.
318. (January, 1886.) English and American Railroads Compared: Edward B. Dorsey.
319. (February.) The Disintegration of the Egyptian Obelisk in the Central Park, New York: T. Egleston.
320. (February.) Formulas for the Weights of Iron and Steel Railway Bridges under Standard Specifications: George H. Pegram—with Discussion.
321. (February.) An Account of Some Observations of Street Traffic: Francis V. Greene.
322. (February.) Remarks on the Aeration of Water—Charles B. Brush—with Discussion.
323. (March.) The Abt Sytem of Railway for Steep Inclines: Walton W. Evans.
324. (March.) Early Surveys and Reports in reference to the Transmission of Trade across the Alleghany Mountains in Pennsylvania, known as the Allegheny Portage: Moncure Robinson.

325. (April.) Discussions on the South Pass Jetties.
326. (May.) The Spongilla in Main Pipes; Desmond FitzGerald.
327. (May.) On Increasing the Accuracy of a System of Magnetic Bearings of a Survey: Olin H. Landreth.
328. (May.) Mexican Bridge Construction: J. Foster Flagg.
329. (May.) Excavation and Embankment by Water Power: Edward B. Dorsey.
330. (May.) Permanent Transmitting Dynamometer: Charles A. Smith.
331. (May.) Data for Flattening the Ends of Railroad Curves: Albon P. Man, Jr.
332. (May.) On Cranes as Labor-Saving Appliances: C. J. Appleby.
333. (May.) Thermometer Scales: Fred Brooks.
334. (May.) The Steamship America: Robert Gordon.

Abstract of the following papers have been issued in Records of Meetings: "European Sewerage and Garbage Removal," W. Howard White; "Water Works of Southington, Conn," T.H.McKenzie; "On the work done for the Preservation of the Dam at Holyoke, Mass., in 1885," Clemens Herschel; "Errors in Railroad Levels," H. V. Hinckley; "Evaporation," Desmond FitzGerald;

The following papers, not yet published, are also open for discussion. Abstracts of either of these will be sent to members who desire to discuss them;

"Vibration of Bridges," S. W. Robinson; "Description of Guard Gates at the Point Street Bridge at Providence, R. I.," W. D. Bullock; "On the Strength of Columns: Discussing the Experiments which have been accumulated, and proposing new formulas," Thomas H. Johnson; "The Cause and Prevention of the Decay of Building Stone," T. Egleston; "On Specifications for Strength of Iron Bridges," Joseph M. Wilson; "New Formula for Compression Member," R. Krohn.

It is expected that papers on several interesting subjects will be presented. Reports are expected from the following Committees:

On Uniform Standard Time; To Consider Changes in Organization; To Consider a Plan for Creating a Library for Joint Use; To Consider the Proper Relation to each other of the Sections of Railway Wheels and Rails; On the Compressive Strength of Cements and the Compression of Cements and Settlement of Masonry.

Discussion is requested upon any of the above subjecis by members who cannot attend the Convention.

The Secretary will be glad to present these if forwarded to him previous to the Convention.

It is desirable that papers offered for presentation at the Convention be sent to the Secretary not later than June 12th, so that proper attention may be given the subjects presented.

JOHN BOGART,
May 25th, 1886. *Secretary Am. Soc. C. E.*

The American Society of Civil Engineers.

The Society met at 20 o'clock Wednesday. Past President George S. Greene in the chair: John Bogart, Secretary.

The following candidates were elected as members: William Algernon Brackenridge, Brooklyn, N. Y.; Robert Gillham, Kansas City, Mo.; Arthur Henshaw Howland, Boston, Mass.; Richard Leveridge Hoxie, Montgomery, Ala.; Herbert Sherman Huson, North Yakima, Wash. Ter.; Charles Edward Jackson, New York City; William Henry Lawton, Jr., Newport, R. I.; Samuel Bingham McKee, Montreal, Can.; Charles Henry Sawyer, Stanberry, Mo.; John Stewart Schaeffer, Newark, N. J.; Addison Moffat Scott, Charleston, W. Va.; John Findley Wallace, Keithsburg, Ill. As Associate, Calvin Milton Woodward, St. Louis, Mo. As Juniors: Samuel Eben Barney, Jr. New Haven, Conn.; Charles Pierre Bonnett, Morris Dock, New York City; Nathaniel Oliver Goldsmith, Glendale, Ohio; Charles Malon Mills, New York City; Henry Bowman Seaman, Brooklyn, N. Y. The election of Joseph Albright, of Buffalo, N. Y. as a Fellow of the Society was announced.

A paper by Palmer C. Ricketts, Assoc. Am. Soc. C. E. on "Some Constants of Structural Steel" was read and discussed.

A model of an apparatus for climbing chimneys for purposes of construction and repair, was exhibited by Mr. Arthur Westcott, of Liverpool, Eng. Four French engineers, on a professional tour of this country, were introduced by the Secretary, after adjournment.

The Connecticut Association of Civil Engineers.

The ninth meeting of the Connecticut Association of Civil Engineers and Surveyors was held in the City Hall, Hartford, Conn., May 26th, about 30 members being present. Among the features of these meetings is the presentation by members of blue prints of work in which they have been concerned. Among those received were two or three of the Greenville dam at Norwich, also designs for plumbing and other matters of professional interest. The first paper was by T. H. McKenzie and was a description of the Southington water-works. The storage reservoir has a capacity of 60,000,000 gallons and is supplied from a region in which there are only three houses on the entire watershed. Three-quarters of a mile below is the distribution reservoir with a capacity of 3,000,000 gallons and a dam of solid masonry 170 feet long. The gates are so arranged that water can be taken at any desired level and the well in the gate house can be emptied in five minutes. The gate house is on the inner side of the dam. The supply furnishes a head of from 200 to 240 feet in most of the area supplied with water.

In the discussion following this paper Mr. Henry W. Ayres, Engineer of the Hartford water-works, was asked as to the comparative advantages of inside and outside gates. He said that outside gates were usually cheaper and gave better opportunities to control the water. This arrangement does away with the gate house, which is costly. The question, however, is affected by the local conditions. Under the present arrangement of the Hartford works water can be taken from any desired level, and that near the botton, which is not so good can be drawn off through other channels. Mr. B. H. Hull, the Engineer of the new Bridgeport water-works, gave some account of the plan there adopted and of the progress made. He said that no city in the country had so suffered from bad water as Bridgeport has during the past twenty years. The water was drawn from the bottom of the pond, and was commonly called "bog soup." The new dam is to be 624 feet long, the reservoir being six miles from the city. In laying the pipes it will be necessary to tunnel some 2,600 feet through the solid rock. Other members spoke on the same subject, among them Mr. Augur, City Engineer of Middletown, who explained an arrangement in use there. Mr. N. J. Welton, of Waterbury, said about half half the reservoirs in the State had inside gates. He himself preferred that plan.

Mr. F. W. Whitlock, of Waterbury, read an interesting paper on sewer assessments which contained much valuable matter.

The papers will be published in full in the transactions in due time, and will then be further noticed in these columns.

Southern Society of Civil Engineers.

At the meeting May 19th the following gentlemen were elected:

HONORARY MEMBERS.—Brevet Major General Q. A. Gillmore, Colonel of Engineers United States Army, New York City; E. G. Woodford, Civil and Mining Engineer, Associate Member Institute of Civil Engineers of England, City of Mexico, Mex.

SENIOR MEMBER.—L. S. Randolph, Mechanical Engineer, Stevens Institute of Technology, 1883, Superintendent of Motive Power Florida Railway and Navigation Company, Jacksonville, Fla.

The President, H. S. Duval, explained and illustrated a new and remarkable principle of hydrostatics, discovered by him, concerning the flow of water in pipes, which was discussed by Messrs. Smith, Ellis, Cloud and Barbot.

Liverpool Engineering Society.

The usual fortnightly meeting of this society was held on Wednesday, May 5th, at the Royal Institution, Colquitt-street; Mr. Coard S. Pain, Assoc. Inst. C. E., president, in the chair. A paper by Mr. J. N. Shoolbred, B. A., M. Inst. C. E., entitled, "Tidal works on the Seine, and on other rivers," was read by the author. The river Seine is affected by the flow of the tide for about ninety-three miles above Havre, of which the upper fifty-two call for no remark, for the next twenty-five miles lower down the channel has been confined, where required, within a narrow width, and its navigable bed considerably improved by means of H. W. training walls of rubble stone. The result has been to reciaim 20,000 acres of slob lands behind these walls, which formerly formed part of the bed of the river. These works were begun in 1845 and ended in 1867. The estuary, sixteen miles long, forms the lowest portion of the tidal compartment. Soon after the completion of the river-walls, accumulations of sea-borne sand from the coast of Calvados began to be felt in the north-eastern part of the estuary in consequence of the river being no longer available. These accumulations have been gradually extending seawards, till their area amounts to about 40,000 acres. The tidal capacity of the estuary has been diminished by one- third. The entrance of the port of Havre is now very seriously threatened, the yearly accretions in its vicinity having amounted, for some time past, to about eight millions of cubic yards. So that the earlier improvement in the navigation of the river Seine threatens to be more than counterbalanced by the deterioration of its estuary. The reclamation works on the Gironde, the Dee, and the Ribble are then briefly described, as also are the improvements by dredging on the Clyde, the Tyne, and the Tees. The Mersey is then touched upon, and also the effect upon it of the several proposals made in connection with the Manchester Ship Canal, with illustrative examples, such as the Thames and Avon, in addition to the preceeding, which bear upon the matter in question.

Short-cuts and Approximations.

To find the number of tons of rails per mile, multiply the weight in pounds per yard by $\frac{1}{9}$ (exact).

To find the cost of work extending over a series of years where the annual expenditure is uniform. Let a = annual payments, r = rate of interest per cent. n = number of years, then

$$\text{cost} = \frac{a(1+r)^n - a}{r} \text{ (exact).}$$

To reduce velocity in miles per hour to feet per second, multiply by $\frac{44}{30}$ or $1\frac{1}{2}$.

To find the pressure in pounds per square inch of a column of water, multiply the height in feet by .43.

To find the height in feet of a column of water when the pressure in pounds per square inch is known, multiply pressure by 2.3.

To find the height in feet to which a suction pump will draw water effectively, multiply average height of barometer in inches by .75.

To find horse-power of a water-fall, multiply cubic feet per second × height of fall by .1.

To reduce cubic inches to cubic feet, multiply by .00058.

To reduce cubic feet to cubic yards, multiply by .03704.

To reduce cubic inches to U. S. gallons, multiply by .00433.

To reduce cubic feet to U. S. gallons, multiply by 7.48.

To reduce U. S. gallons to feet, multiply by .134.

To reduce imperials to U. S. gallons, multiply by 1.2.

To reduce pounds avordupois to net tons, multiply by .0005.

To reduce pounds to gross tons, multiply by .00045.

To reduce pounds to cwts., multiply by .009.

To find the horse-power of any boiler, multiply the total area of heating surface by .1, or if a nearer approximation is wished, by the constants for different styles of boilers given below:

For plain cylindrical boilers	.125
" large flue boilers	.1
" return tubular boilers	.067
" locomotive boilers	.077
" upright tubular boilers	.05
" water tube or sectional boilers	.09

The breaking weight of ordinary hemp centered wire rope, nineteen wires to the strand, varies approximately with the squares of the diameters taken in quarter of an inch, *e.g.*, the breaking weight of a rope 1 inch in diameter $\frac{4}{4} = 16$ net tons of a 2-inch rope $\frac{8}{4} = 64$ net tons, about $\frac{1}{6}$ of which is safe for hoisting.

CORRESPONDENCE.

Ventilation of the New Croton Aqueduct:—Correction.

NEW YORK, June 1, 1886.

EDITOR ENGINEERING NEWS:

In the report of the Board of Health, published in your last, speaking of the systems and appliances for ventilation used on the Aqueduct, I am quoted "It would be perfect if the problem were: how not to do it." My report to the Chief contains that phrase, but only in connection with the upper end of the work—that above Tarrytown—not the whole. As I do not wish to ridicule honest endeavor I wish you would make this correction. C. L. KALMBACH, Insptr.

River and Harbor Improvements.

U. S. ENGINEER OFFICE, 378 St. Paul St.
BALTIMORE, Md., May 25, 1886.

Proprietors of the Sun, Baltimore, Md.

GENTLEMEN, I have been requested to address you a letter on the subject of the improvement of rivers and harbors in the United States; I comply, though always hesitating about obtruding upon the public my views on any subject. Of course it remains with you to decline their publication, in your discretion,

The river and harbor bill, when annually under discussion in Congress, is generally vigorously criticized in the metropolitan newspapers, and the cue is taken from them by the provincial press. As was well remarked by Hon. Mr. Wilson, of West Virginia, in a recent speech in Congress, "much of the criticism indulged in by the press of some sections of the country, and echoed in the debates on this floor, is unfounded and uninformed."

These criticisms are usually of a very general character and seldom go into details. The truth is that no bill on any subject containing many items is going to be free from objections so long as men are legislators and so many diverse interests are to be considered. If river and harbor bills be analyzed it will generally be found that the percentage of improper items is very small.

A great prejudice has grown up in the country with reference to this matter. Thorough ventilation would do great good. A rule reported to have been lately adopted in the Senate is an excellent one, requiring their committee on commerce to give reasons why each item they recommend should be appropriated for. This will cause a thorough discussion and scrutiny of each item.

It is very doubtful whether a single one of these objectors ever read through a river and harbor bill, although very ready to talk about "mud-puddles," etc. We heard recently from an influential quarter a sneer about the improvement of the "roaring Kanawha." This gentleman, well-meaning but "uninformed," as Mr. Wilson remarked, does not know that the Kanawha is in its ordinary stage as great a river as the Seine at Paris, and flows through one of the finest coal fields in the world. It is derided because in the low water of summer some of the shoals are impassable except by vessels of very light draft. But there is abundance of water in the river at all times if properly utilized to make a navigable depth of not less than six or seven feet at the lowest stages, and to do this is the object of the improvement.

This is a short river, entirely within a single state, and yet its improvement is a subject of national importance, as was clearly stated by Mr. Wilson, from whose speech already referred to, the following quotation is taken:

"Even in a greater degree is this true of the amount expended for the Great Kanawha river. While the locks and dams which have been placed upon that stream have during their construction given temporary employment to labor in West Virginia, and have developed a line of magnificent colleries along that river, these improvements have also provided an outlet for the products of those mines, and permanently cheapened coal to the dwellers along the Ohio and the Mississippi, and the few hundreds of thousands of dollars expended in this work, which, according to the gentleman from Iowa, is local, have thus extended their benefits to many surrounding states."

If you approve, I will continue this subject in another communication, taking the liberty to close this by an extract from another and recent speech in the Senate, which contains most important statistics and arguments:

"In a newly settled country the natural water-courses are the only highways available for heavy transportation. As population increases and the country is developed, railways are built, and, for a time, they can do all the business required, thus apparently superseding water transportation altogether; but as the wealth and density of population still further increase the necessity for water transportation again asserts itself. So true is this that now on all sides we find a cry raised for the improvement and greater use of water ways. The necessity for paying increased attention to our inland navigation has been forced upon the public in this country by the combination which railway companies have managed so skilfully to arrange and work for their exclusive benefit. It is not in this country alone, however, that a tendency to revert to the older means of transit is noticeable. Throughout the world of commerce the desire for more direct means of conveying goods in bulk prevails."

"By the cession of Alsace and Lorraine, France lost the connection between the northern tributaries of the Rhone and the Rhine, which were united at Strasburg. She set to work without delay to reunite these two lines of communication by a new canal, constructed on their side of the Vosges, the estimated cost of which was sixty-five million francs. This work must now be complete, or drawing towards completion. Even the Russians have been at work converting St. Petersburg into a seaport by a canal twenty miles in length. At the mouth of the Danube and the Mississippi great improvements have been carried out with marked success, giving to the Danube twenty feet of water in place of 9 feet, and increasing the low-water depths of the Mississippi from 8 feet to 30 feet, with the result that the exports from New Orleans have increased many fold. Manchester is about forty miles from Liverpool, with six lines of railway connecting the two cities, yet it is proposed to connect the two cities by a ship-canal to cost $40,000,000, as the numerous railway lines are considered insufficient to transport economically heavy and bulky merchandise. In this connection I desire to read a statement by Major W. R. King, one of the ablest of the corps of engineers of the United States army:

"This is evident from the experience of older countries, for, although we are in our own estimation a wonderful nation, we are not exempt from the laws of nature, will probably obey 'manifest destiny' about as others have done before us, and we are not so wise but that we may profitably take lessons from their experience. France, for example, with an area of about four-fifths as large as our State of Texas, and a population thirteen times denser than that of the United States, has 18,000 miles of railway, or about one mile of railway to eleven miles of territory, while the United States have only one mile of railway to twenty-nine miles of territory.

"Notwithstanding these facts and the enormous strain upon her finances for war expenses and indemnity, France is expending sums on her water-ways that would make our short sighed economists howl with alarm. For rivers, she proposes to expend $13,200,000; for canals, $142,600,000; for harbors, $20,000,000, making in all $175,800,000 to be expended in the immediate future for these improvements—a sum larger than all that has been expended for rivers and harbors by the United States since the foundation of the government. This last, including all unexpended balances, amounts to only $136,112,576, and if we include the $31,021,423, which covers all that has been expended by states and private corporations for river improvements, so far as can be ascertained, the amount would still be only $167,134,000, or $8,000,000 less than this one appropriation by the French.

"Germany affords another excellent example of how river navigation ought to be developed. With an area almost equal to that of France, and only one-seventeenth as great as the United States, she has fifteen times our density of population, and a mile of railroad to every nine square miles of territory, instead of one to twenty-nine, as we have. She finds it advantageous, however, to expend far greater sums for river improvements than the most enthusiastic advocate of internal improvements would think of expending on our rivers. On one stream not as large as some of the branches of the Tennessee, say the Holston or Clinch, she has expended $20,000,000, and I am informed that a cable-towage company on one of these rivers, which is too rapid for ordinary navigation, has a chain cable 100 miles long, which enables boats to make regular trips according to schedule and carry freight at about half a cent per ton per mile, for short as well as for long distances. This towage company pays six per cent. dividends on its capital stock, which is considered a good investment in that country."

"Among the advantages of river improvements may be mentioned: 1. They furnish means for the transportation of heavy and bulky commodities, such as coal, iron, ore, scrap and pig iron, stone and timber, which often will not pay the cost of transportation by rail; 2. They keep in check the grasping tendencies of railway companies by controlling freight rates and facilities."

In the next communication I propose to refer especially to the smaller works of Maryland.

Respectfully yours,
WM. P. CRAIGHILL.

Review of the Foreign Engineering and Industrial Press.

Specially prepared for ENGINEERING NEWS.

Le Genie Civil.—The last number has an interesting article on the meter for steam and fluids invented by M. Parenty. It is, in fact, an apparatus consisting of a rheometer, a steam gauge (differential with mercury), a balance beam, a weighing cam and a graphic register. The series of articles on the exhibition of public works appliances, which was organized by the syndicate of French contractors, is continued, trucks and inclined planes being reviewed. The paper has lost one of its most eminent contributors, M. Leon Boyer, general director of the Panama canal works. He fell a victim to the yellow fever at the early age of thirty-five. He will be best known, however, by his masterly achievement, the construction of the famous Garabit viaduct, which has a span of 165 metres, at a height of 124 metres. We are glad to see the *Genie Civil* keep up its high standard of excellence, although it draws upon a larger field than would be possible for a paper in this country, where specialties are sharply defined in journalism. The French scientific papers contain very able articles, but owing to the lack of advertisements and enterprise the trade journals are generally very mediocre. A rag, said to represent the iron interest is so utterly shabby that it would scarcely answer for unanswerable purposes.

Les Annales des Travaux Publics.—The metallic bridge-aqueducts built in Paris by the *Chemin de fer de l'Est* furnish the material for the principal article in the last number. The illustrated foreign chronicle is, as usual, very well done.

Zeitschrift des Oest Ing. u. Arch. Vereins.—The Austrian Engineers and Architects Society have the unusual allowance o two publications—a weekly and a quarterly, the latter containing the more lengthy contributions. A lecture by P. Klunzinger on "The relations of a system of river regulating with the carrying off of floods" is a continuation of the views of the author which are backed up by several formulæ and calcula-

tions. Some of his remarks seem very sensible, although he confesses that his investigations have not been sufficiently extensive. He says "Everything that contributes to a greater rapidity of the water discharge will produce an increase of the high water." In the general formula for the rapidity of water courses:

$$v = K\sqrt{R\ J}$$

the increase of each of the three factors will be attended with an increase of the rapidity, and of the high water. The high waters are therefore increased altogether independently of the duration of the rain and of the flow elevation by:

1. A lessening of the roughness of the profile, that is by an augmentation of the co-efficient K or, in other words by regulating and evening the river bed, and the banks of all the water courses in the region.

2. By an increase of the hydraulic depth R, that is, by deepening, or elevating the water cross section, generally by narrowing the high water profile by means of dams etc.

3. By strengthening the fall J of the water courses, and consequently by the removal of windings. The subject of floods and freshets is one of peculiar interest to engineers in this country, and one that calls for more attention. There is also a very exhaustive article, especially so far as Austro-Hungary is concerned, on "The development of iron production during the last ten years." Some fine drawings of the New Court Museum in Vienna, complete a very good number.

Rivista di Artiglieria e Genio.—We have received several numbers of this publication from the Italian Artillery and Engineering Department. Most of the articles are, as might be expected of a military engineering character. An article by Captain Mirandoli on Military Engineers, or rather, on the different branches of what the author terms "technical infantry," shows that the "sappers and miners" are not yet doomed to find their occupation gone. "The manufacture of large cannons abroad" is a continued article and is an indication of how closely military men are observing what is being done in projectiles.

Moniteur Industriel (*Brussels*).—The continued labor troubles in Belgium have their origin in the depressed condition of the iron and coal industries. The Belgian journals deny however, that the situation is as gloomy as depicted by the English press. The Cockerill Company has taken away some few orders for rails for Australia, and there is a fair amount of work on hand. It is believed that the selection of Antwerp as a port of call for the North-German and the Danish lines of steamers will be productive of a good deal of new trade. An article on the projected Metropolitan (Elevated) road in Paris deals mainly with the objection of the *Société des Amis des Monuments Parisiens* to the proposed route. The march of improvement cannot well be delayed, but the Parisians will hardly approve any line that would seriously detract from the artistic aspect of their city. Still the Romans seem to view with great complacency the running of new roads over their classic highways and the Italian papers were very abusive a short time ago of an English society that wanted to preserve the "Stones of Venice." No hoar antiquity stands in the way of the engineer's utilitarian projects in this country.

Eisen Zeitung.—The German iron trade is much exercised by the recent advance of the Russian duties, which are now almost prohibitory. In 1877, the duties were increased fifty per cent.; in 1881 a further advance of ten per cent. was made, while in 1882 the duties on some manufactured articles, as wire, were altogether prohibitory, 80, 100, 200 and even 400 per cent. *ad valorem*. There is at present a real and a bitter industrial war being waged between England, Germany, France and Belgium.

THE *Bell* made a small advertising contract the other day. The advertisement was to go in thirteen times top column next to poetry, following and preceding pure matter notices, paper sent regularly during life of contract, electrotype used, failures to insert made up, editorial mention, electro underlaid, 3 mo., tf. e. o. w. d., & w. p. d. q. etc. No pay if these conditions were not lived up to. They now write us and say that "if you prefer it to cash, we will send you the amount in Godfrey's anti-suction rubber composition." Godfrey's anti-suction rubber composition! After all these conditions to want to load us up with Godfrey's anti-suction rubber composition! Gail! fellow mortals, gail! —Estelline (Dak.) *Bell*.

COLUMBUS, O.—The Board of Trade has indorsed the enactment of a law to permit the water-works trustees to contract for a new pumping engine without having the money in the treasury; the pump to be paid for by the earnings of the works.

Another Home-Made Testing Machine.

U. S. ENGINEER OFFICE,
JACKSONVILLE, FLA., May 26, 1886.

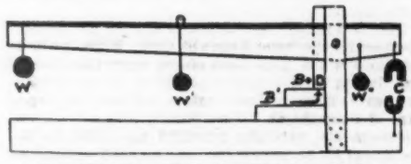
EDITOR ENGINEERING NEWS:

I send you herewith a drawing and description of a testing machine which has proved most useful to us this winter in our work at Fort Marion.

Hoping that it may be of interest and use to other engineers, I am,

Very respectively yours,
W. M. BLACK,
First Lieut. of Engineers, U. S. A.

The machine as herewith illustrated consists essentially of a counterpoised wooden lever 10 feet long, working on a horizontal pin between two broad uprights 20 inches from one end. Along the top of the long arm runs a grooved wheel carrying a weight. The distances from the fulcrum in feet and inches are marked on the surface of the lever. A clip for tensile tests is suspended from the short arm 18 inches from the fulcrum. Pressure for shearing and compressive stresses is communicated through a loose upright, set under the long arm at any desired distance (generally 6 or 12 inches) from the fulcrum.



W. Fixed Weight. *W*. Rolling Weight. *W*. Counterpoise. *B*. Block for Shearing. *B*. Block for Crushing. *C*. Tensile Strain Clips.

The lower clip for tensile strains is fastened to the bed plate. On this plate the cube to be crushed rests between blocks of wood, and to it is fastened an upright with a square mortise at the proper height for blocks to be sheared. The rail on which the wheel runs is a piece of light T iron fastened on top of the lever. The pin is iron. The pin holes are reinforced by iron washers. The clips are wood and are fastened by clevis joints to the lever arm and bed plate respectively. When great stresses are desired extra weights are hung on the end of the long arm.

This simple but effective machine was made at Fort Marion, St. Augustine, Fla., out of materials on hand by the ordinary workmen employed on the repairs of the fort. Most of its details were devised by Mr. F. W. Bruce, U. S. Overseer at the fort. During the past winter it has done very effective work in testing cement, coquina, concrete and natural coquina rock. Pressures of 3,000 pounds have been developed with it. Improvements suggest themselves from time to time as the machine is used.

MINNEAPOLIS, MINN.—The following are the salaries fixed for the current year for the city officials:

Attorney	$3,000
Assistant Attorney	1,500
Comptroller	2,500
Deputy	800
Treasurer	1,200
Clerk and Assistants	2,500
Assistant Clerk	1,000
Engineer	3,500
Superintendent of Poor	2,000
Clerk	900
Physician	1,500
Health Officer	1,500
Building Inspector	2,000
First Assistant	1,500
Assistants	900
Meat Inspector	1,500
Assistant	1,200
Street Commissioners	800
Pound Masters	500

BOSTON, MASS.—The committee on sewers has recommended that a loan of $500,000 be placed in the sinking fund to construct a system of sewers, the places and expenses being as follows: In Ashmont, $120,000; other districts in Dorchester, $95 000; Beacon street, $25,000; Brighton district, $75,000; West Roxbury district, $75,000; city proper, $120,000.

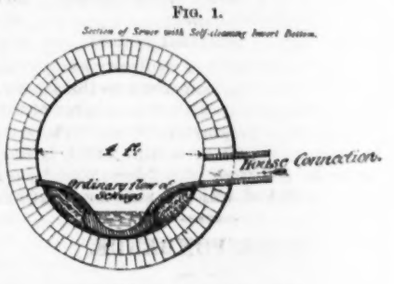
WATER

FROM the report of Stevenson Towle, C. E., late Chief Engineer of Sewerage of this city we extract the following:

Systematic examinations of the old sewers have brought to light many unexpected defects, several of which are of serious character and will have to receive immediate attention. Sewers heretofore free from obstructions are now found filled with deposits of ashes and street-dirt, mixed with solid sewage matter and manufactory wastes, all of which have to be removed by hand at great cost. One cause of this obstruction is to be found in the recent economy practiced in the use of Croton water, the free and constant use of which hitherto served to flush the old sewers and keep them free from obstructions, overcoming to a great extent their imperfect form and arrangement. Another cause is the practice of the men employed in the Street Cleaning Department of lodging street-sweepings in the gutters, and of sometimes depositing it in the street basins direct.

Many of the old sewers are of a size very much larger than can be flushed or kept clean by the small quantity of sewage passing through them, which, spread over the broad bottom of the sewers, has less velocity than is necessary to carry on its solid portion, which latter settles and accumulates, until it becomes necessary to remove it by hand. Many such sewers are of excellent and durable workmanship; and to replace them by sewers of proper size and form, would be both expensive and unwarranted, especially when located in crowded business thoroughfares. It is found practicable however, to form a new invert bottom within these sewers, without disturbing them or the streets in which they are laid; and this has been done in several instances with great success, causing no inconvenience to the traveling public, by permitting our laborers to enter the sewers through the manholes, and to carry on the work of building the new floor or invert to an uniform grade throughout, entirely inside of the sewers, and without breaking them down or altering their external size or shape. The flow of sewage increases in depth when confined within the smooth sides and bottoms of these inverts, and its velocity is so greatly accelerated that no deposit can take place.

FIG. 1.



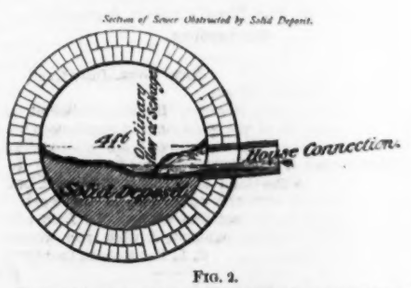


FIG. 2.

Figure No. 1, in the annexed plan, shows a section of sewer with new invert bottom, formed of concrete, with facing of vitrified earthenware moulded to shape; and figure No. 2, a section of old sewer filled with deposit.

GALESBURG, Ill.—The proposed new system of waterworks, contemplates a large reservoir, four miles distant from the city. The dam at the head of this reservoir is located over a mile east of the C. B. & Q. R. R. east of Galesburg. It extends east and west across Court Creek, which, with two branches from the north, makes the source of supply. It will be 400 feet long, and 18 feet high. The greatest width of the reservoir is about 800 feet. Forty-five acres will be flooded, the water extending back three-quarters of a mile. The capacity of this reservoir is now estimated at $130,000,000 gallons. The system of mains will include four miles of 16 inch main. Within the city there will be thirteen miles of main, additional to that of the old works, making a total of twenty one miles. All save one mile of this will be from twelve to six-inch pipe. The one mile will be 4-inch pipe. It is proposed to putin 145 new hydrants, making a total of 225. With regard the the sale of the old works, unless the city becomes

the purchaser under this decree we do not at first view, see how it can engage in the construction of new water works. The valuable part of the present Company's properties is the franchise, and the Court having ordered this to be sold would probably interfere to prevent the city taking any action to render it of no value in the hands of a purchaser.—Galesburg *Republican Register*.

ALBANY, N. Y.—The special water commissioners have decided to go on under the Act creating them, and award contracts for the erection of a plant for driven wells and the necessary machinery for supplying the city with water by that means.

KANSAS CITY, Mo.—Proposals are invited for twelve miles of cast-iron water-pipe, to sustain a pressure of 300 pounds to the square inch, for the new water-works. The capacity of the machinery is to be 2,500,000 gallons per twenty-four hours.

LINCOLN, NEB.—The sewerage plans drawn by Chester B. Davis and George E. Waring have arrived and are on exhibition side by side in the council chamber. To the average citizen they are about as interesting to look at as a panorama exhibition of the Holy Land and as intelligible as the marks on a tea chest fresh from Hong Kong.—Lincoln, *Nebraska State News*.

PRINCETON, ILL., is considering the question of introducing water-works, and a scheme has been presented to the council by J. L. Hotchkin; his proposition is to put in ninety public hydrants at an annual cost of $4,000, for ten years, with the privilege of the city buying the plant outright by that time, if deemed advisable.

CONEY ISLAND.—The route of the new sewer being constructed by the Gravesend Board of Health, is as follows: one of the main pipes runs from the caisson on the north side of the creek down West Fifteenth street through Coney Island creek and to Surf avenue, along which it will proceed as far as Paul Bauer's hotel, from which point a smaller pipe will continue along Surf avenue to West Fifth street, which is east of the Vanderveer property, and down West Fifth street to an avenue a quarter of a mile north of Surf avenue. Down this it will proceed to West Fifteenth street again, the main pipes thus forming a square enclosing all the most important buildings on Coney Island. At the caisson the sewage will be deodorized and used for farm purposes, under the system of James J. Powers, the sanitary engineer of the city, with whom City Engineer Robert C. Van Buren is associated in the capacity of consulting engineer. The hotel keepers and railroad men are up in arms against the prosecution of the work, claiming that the tearing up of the streets will ruin the season's business, and that even if proceeded with it will not be available until the next season, and may therefore reasonably be constructed after the present season is over.

LINCOLN, NEB.—The following is the estimate of cost submitted with plans and specifications for a system of sewage by Mr. Geo. E. Waring:

Size.	Length.	Av'ge d'pth of cut.	Cost per ft.	Total cost.
inch	feet	feet		
6.....	80,930	8	$ .35	$28,325.50
8.....	35,670	8	.41	14,624.70
10.....	2,830	8	.43	1,216.90
12.....	4,430	8	.50	2,215.00
15.....	3,210	8	.75	2,407.50
18.....	1,230	8	.90	1,107.00
20.....	2,740	8	1.10	3,014.00
Totals.....	131,040	.....	.....	$52,910.60
Add for cutting deeper than 8 feet.....				387.50
				$53,298.10
Cost of distributing pipe.....				2,179.00
Total cost of pipe laying, excavating and distributing.....				$55,477.10
Manholes, 17, at $30.....				510.00
Flush tanks, 105, at $50.....				5,250.00
Flush tank (500 gallons), 1 at $100.....				100.00
Flush tank, (10,000 gallons), 1 at $1,000.....				1,000.00
Total.....				$62,337.10
Add ten per cent. for contingencies.....				6,233.71
Total.....				$68,570.81
Add fifteen per cent. for engineering.....				10,286.62
Total.....				$78,857.43
Royalty on 131,040 feet of sewers at ten cents..				13,104.00
Grand total.....				$91,971.43

MINNEAPOLIS, KAN., is to have a system of water-works. Address M. A. Arnott.

No. 16. Water Pressure in Mains of Various Cities.

COMPILED BY J. J. R. CROES. FROM SPECIAL RETURNS, JAN., 1886.

Town and State.	Topography.	Difference of level in town.	In Business District.		
			Day Pressure.	Night Pressure.	Fire Pressure
		feet.	lbs.	lbs.	lbs.
Lansdale, Pa.	———	0	50	50	50
Litchfield, Ill.	level.	0	60 to 70	80 to 100	80 to 125
Longmont, Col.	rolling.	15	80	95	135
Martinsburg, W. Va.	hilly.	———	35	35	65
Mason City, Ia.	rolling.	10	75	75	100 to 125
Massillon, Ohio.	hilly.	75 to 125	35	35	35
Mattoon, Ill.	level.	0	25	25	150
Maysville, Ky.	rolling.	———	150	150	150
Menominee, Mich.	level.	———	40	40	70 to 125
Menomonee, Wis.	level.	———	72 to 100	72 to 100	80
Nor. Attleboro, Mass.	hilly.	———	82	82	150
North Conway, N. H.	hilly.	40	70	90	70 to 90
Norwalk, Ohio.	level.	50	45	45	80 to 90
Norwich, N. Y.	level.	50 to 60	70 to 75	70 to 75	50 to 75
Owensboro, Ky.	rolling.	———	50 to 60	50 to 60	125
Owen Sound, Ont.	level.	10 to 15	70	73 to 75	70 to 75
Peru, Ind.	level.	0	38	40½	75
Pittston, Pa.	hilly.	———	40	———	———
Plymouth, Mass.	hilly.	———	36	22	76
Rockford, Ill.	level.	40 to 60	40	60	95 to 150
Rome, Ga.	hilly.	———	77	77	77
Saratoga Spr'gs, N.Y.	sloping.	166	80	83	100 to 130
South Bend, Ind.	level.	30	70	75	100
Torrington, Conn.	level.	30	50	70	50 to 70
Woburn, Mass.	hilly.	———	65	70	65

COLEMAN, TEX.—Subscriptions are being received for building water-works.

PINE BLUFF, ARK.—Negotiations are in hand for establishing a Holly system of water-works.

SPARTANBURG, S. C.—A proposition has been made to build water-works.

JAMESTOWN, DAK.—The proposals for new water-works will be opened to-day.

EL PASO, TEX., will issue bonds to construct an extensive sewerage system.

CHATTANOOGA, TENN.—A company has been incorporated by Charles G. Anderson, M. H. Clift,—Mahan,—Trimble, and J. A. Hart to build water-works.

ST. CHARLES, MINN.—The city has let the contract for building a system of water-works to M. Toye of Winona. There will be 3,600 feet of 8-inch main.

TRENTON, MO.—The Trenton Water Company has been incorporated with a capital stock of $75,000. Adam H. McCormick and others, incorporators.

OSCODA, MICH.—The tax-payers have voted to bond the village for $7,000, for the purpose of putting in a complete system of water-works.

COLUMBUS, NEB.—Proposals for the erection of the new water-works have been opened; the bid of J. D. Brewster of the same city was the lowest—$20,000.

LONOKE, ARK.—The Town Council is agitating the question of erecting water-works at that place, and there is probability of the work being done shortly.

YORK, NEB.—The contract for the water-works has been awarded to W. J. Cooper, of Lincoln, at his bid of $29,350. A. L. Strang, of Omaha, bid exactly the same figure.

ST. LOUIS, MO.—The Board of Public Improvements has appropriated $65,000 out of the water pipe fund for the purpose of extending and laying new lines of pipe on a large number of streets.

LITTLE ROCK, ARK.—The Home Water Co., has completed the new pump house and begun to set the pumps. The work in the settling and distributing reservoirs is progressing rapidly.

BRECKENRIDGE, COL.—A special election was held May 25th, for voting on the issue of $8,000 in bonds for erecting a reservoir system of water-works. The result was two to one in favor of issuing the bonds, and the City Council will proceed to contract for the work.

WABASH, IND.—The City Council has notified Jesse W. Starr, the Philadelphia water-works contractor, that unless he resumes work on the city water-works within the next fifteen days the contract will be cancelled. Operations were commenced in September, and when winter set in the work was abandoned and has not been begun this spring.

SILVERTON, COL.—The Silverton Water Company has sued the town on complaint that the ordinance granting the charter provided that the town should pay $2,900 per annum for the use of water for twelve hydrants; when the case came up recently the town attorneys claimed that the ordinance was not passed by a vote of ayes and noes, as appeared by the town records, and it was, therefore, illegal, and that the town government can only pay the water-works a 3-mill tax upon the valuation of the town property. The valuation that was made in 1884 being $700,000, the water company was entitled to but $2,100, which the town had offered to pay. This suit was entered about July 1, 1885, and the amount sued for is $1,655 for water rents due up to that time, and interest. Judge Havt rendered judgment for the amount claimed by the Water Company, and the town gave notice of an appeal to the Supreme Court. The Water Company now say they will bring suit for water rents from July 1, 1885, to the present time, at the rate of $1,900 per annum, and the town will fight it on the ground that the company has failed to fulfil the contract by keeping the reservoir water-tight, and that recent tests prove that the water supply is very insufficient for fire purposes.

THE GOSHEN DAM.—People living in the Mill river valley, Northampton, Mass., are apprehensive as to the safety of the dam at the Goshen reservoir: Engineer Davis has examined the embankments twice within a few weeks and reports that there is no occasion for the least alarm. Both the mill owners and those who fear trouble propose to petition the commissioners to make a thorough investigation, and a board of engineers will be empowered to do what they think best to remove any question as to the durability of the dam.

ARTESIAN WELL CAPACITY.—The artesian well being sunk for the Ashcroft Mfg. Co., East Bridgeport, Conn., was tested recently to determine how much water the well would furnish at the present depth. This was done by setting a pump in the well and taking all the water out. Pumping was kept up for several hours, which served to open the seams in the rock from whence the supply is furnished. As the well is only 6 inches in diameter, at the present depth of 165 feet it will only hold, as a reservoir, about 175 gallons, which can be pumped out in a few minutes; then the supply itself is drawn on, and the amount can be determined in one hour's pumping. The well is now 65 feet in earth and 100 feet through solid rock, and will be sunk still deeper in order to increase the already large supply. A recent test showed about 25,000 gallons per day standard.

DRAINAGE IN OHIO.—DEXTER, O., May 31. The Luce Dredging Company, of Toledo and Chicago, will enter upon the work of deepening and widening the channel in Little River in a few days. They have their dredge drill already constructed and launched, and are now putting in the machinery. They expect to put the river in such a condition as to prevent overflow, and thereby reclaim large bodies of land in which they are interested, and also to open up large timber interests. They will commence work where the Cairo branch of the St. Louis, Iron Mountain and Southern Railroad crosses Little River, and work through to the southern boundary of New Madrid county. At the starting point they will put in side tracks for the purpose of giving them shipping facilities for the timber they expect to boat up the river. If this project succeeds—of which there is little doubt, as the company is a strong one, and they say they know what they are undertaking—it will lead to more extensive drainage schemes in this section of the State. A corps of engineers are at work surveying the river, making maps and outlining the work.—St. Louis, (Mo.) *Globe, Democrat*.

RUSSELLVILLE, ARK.—Money is being raised for the purpose of building water-works.

BINGHAMTON, N. Y.—The annual report of the Superintendent of the water-works has been issued. The engines pumped an average of 2,394,418 gallons of water, at a total cost for the year of $1,462.62 for fuel used for pumping. The average daily cost per day for fuel was $4.01. They used 969 tons of screenings and soft coal. The cost of raising 1,000,000 gallons of water 1 foot high was 4½ cents. The gallons of water pumped per pound of coal consumed were 451.

NEWS OF THE WEEK.

CONTRACTING.

Gravel Roads.—At Council Bluffs, Io., an extensive bed of gravel has been struck, and it is proposed to put a layer 2 feet thick on the streets.

Minneapolis, Lyndale & Minnetonka R. R.—Woods and Lovejoy have the contract for grading the first ten miles of this motor line from Hutchinson east.

Dredging.—The Lincoln Park (Chicago) Commissioners have closed contracts with Fitz-Simons & Connell and the Chicago Dredging and Dock Company for work on the breakwater. It will be commenced at once, weather permitting.

Protractors.—The following are the bids received by the Navigation Bureau for three-arm protractors: Keuffel & Esser, New York, $85 per piece; James W. Queen & Co., Philadelphia, $94.50; George Shilling, Washington, $84; Fauth & Co., Washington, twenty protractors, $75 per piece; forty protractors, $79 per piece. Contract awarded to lowest bidder.

Pebbles.—The following is an abstract of bids opened May 20 for 1,600 cubic yards of river-wash in pebbles for State, War and Navy Building: John B. Lord, Washington, $1.30 per cubic yard; Ward & Milstead, Washington, $1.62; R. M. Miller, sample No. 1, $1.86; No. 2, $1.64; No. 3, $1.59; Jacob Leech, $2.50; H. J. Kintz, $3.15 The contract was awarded to J. B. Lord, of Washington, D. C.

Street Paving.—The following proposals have been received by the Department of Public Works, Brooklyn, for paving Bedford avenue:

	Pavement.	Line of Improvement.	Curb-stone.	Bridge Stone.
	per sq. yd.	per lin. ft.	per lin. ft.	per sq. ft.
	$	cents.	cents.	cents.
William Mogk....	2.39	29	45	39
Alliston Gerry....	2.25	60	60	50
Daniel J. Creem..	2.32	50	50	35
James F. Gillen..	2.23	25	50	35
Thomas Newman	2.37	20	52	38
Charles Hart.....	2.17	13	43	37
William Kelly....	2.13	5	44	30
Gregory Cox.....	2.04	13	60	45

Important Improvement in Culvert Pipe.—Messrs. Blackmer & Post, of St. Louis, Mo., who have a national reputation as manufacturers of double strength culvert pipe, have recently made an important improvement in their pipe by increasing the depth of the socket or bell sufficient to make it equal in each size to one-sixth of the diameter of the pipe; and also increasing its thickness proportionately. The difference is shown exactly in the following table:

Diameter of Pipe.	Depth of old Socket.	Depth of improved Socket.
12 inches.	1¾ inches.	2 inches.
14 "	1¾ "	2⅓ "
15 "	1⅞ "	2½ "
16 "	1⅞ "	2⅔ "
18 "	2 "	3 "
20 "	2 "	3⅓ "
21 "	2 "	3½ "
22 "	2¼ "	3⅔ "
24 "	2½ "	4 "

With the improved socket, the connection of one section of pipe with another is easily made, and when made, the joints are the strongest part of the line of pipe; whereas, with the *old socket* the joints are the weakest parts; all danger is avoided of the spigot end of one section of pipe, being displaced and falling out of the socket of the next section by reason of the settling of the ground from heavy rainfall, etc.; less care is needed in connecting the sections, allowing of more progress in the work; the use of cement is less essential, and in many cases entirely unnecessary; a perfectly water-tight joint may be made which cannot be done with absolute security, with the old sockets; and by reason of its greater strength, the risk of damage in transit is reduced to comparatively nothing.

St. Louis & San Francisco R. R.—The engineers have completed plans for a large union depot to be built at the junction of that road with the Little Rock and Fort Smith R. R., at Van Buren, Ark.

Paving.—The Board of Public Works, of Wheeling, W. Va., has let the contract for all the street paving provided for by the appropriation ordinance recently passed by the Council to Col. Robert Campbell, $1.26 per square. This contract calls for a large amount of work to be done this season.

Paving.—The following bids have been received at New Orleans:

C. J. Fayssoux, granite block, $5.50 per superficial yard; curbing, 85 cents per superficial foot; iron bridges, taps, etc., $4.55 each; to reset old curbs, 35 cents per running foot. Thomas J. Coleman, granite block, $5.75 per superficial yard; curbing, 90 cents per superficial foot.

Smith's Falls and Montreal Short Line.—CONTRACTS AWARDED.—The contracts were awarded on Thursday evening last for the construction of the new Air Line between Smith's Falls and Montreal to the following firms:— Messrs. W. Buchner, Chippawa, Ont., section 1; Hutchison, Wood & Molesworth, St. Catharines, section 2; John Drew, section 3; Hutchison, Wood & Molesworth, section 4; L. E. J. Robinson, Hamilton, Ont., section 5; Corbett & Skead, Ottawa, section 6; Breen Connolly, Beggs & McMahon, St. Catharines, sections 7, 8, 9, 10, 11, 12, 13 and 14; J. & W. G. Elliott, Brantford, sections 15, 16 and 17; Fauquier & Dinwoodie, Toronto, sections 18, 19, 20, 21 and 22; Davis Bros., Ottawa, section 23; Ross & Holt, sections 24, 25, and 26. Section 23 comprises bridges at St. Anne's and Vaudreuil. It is expected that the whole work will be finished by October. Mr. P. A. Peterson, C. E., will have charge of the 24 miles from Montreal to Vaudreuil, and Mr. Lumsden, of the remainder of the road, while the whole will be under the supervision of Mr. T. G. Shaughnessy.—[We repeat the above from last week to give addresses of the contractors.—ED. ENG.]

Railroads, Bridges and Canals.

Colorado Midland R. R.—By the premature explosion of a blast on May 28, two contractors, Gill and Maloney, of the contracting firm of Orman, Crook & Co., were killed, and another man, named Foley, fatally injured.

The Brenham & Brazos Valley Railroad Co., capital stock $100,000, has been incorporated in Texas to build a road from Brenham to Waco. The directors are F. A. Engelke, B. Eldridge, Henry Hadde, J. H. Brown, D. C. Giddings and others.

The North Arkansas R. R. Company has been incorporated. President, Wm. Farrell; Vice-President, A. L. Horner; Secretary and Treasurer, Thos. Lafferty; Directors, R. D. Welch, Wm. Frank and E. J. Butler. The line is to run from Ravendon, Lawrence county, on the Kansas City, Springfield & Memphis R. R., northerly to the State line, twenty-five miles. Capital, $250,000.

The Chicago, St. Paul & Kansas City Railroad Company has been incorporated by Ansel Oppenheim, Samuel C. Stickney, A. F. Schiffman, Frank Skipwith, Robert C. Wright, W. H. Knowlton, all of the Minnesota and Northwestern R. R. Co., and also George B. Burch, of Chicago, president of the Dubuque and Northwestern R. R. Co. The capital is $25,000,000, and the road will run from Dubuque to Kansas City.

The Cable Traction Canal Failure.—A steam tug is engaged in taking up the old cable at the bottom of the Erie canal from Gere's Lock, near Syracuse, to Buffalo. This was laid nearly ten years ago and was intended to supplant horses as power for moving canal boats. An English company, engaged in the enterprise, built over thirty boats to be thus propelled. The scheme having proved a disappointment, no cable boats have been used since 1883. They are now mostly collected in Lockport.

Harlem Bridge.—The Union Bridge Co., of Buffalo, are adjudged the lowest bidders for the ironwork on the Harlem Bridge, with the New Jersey Steel and Iron Co. (Cooper, Hewitt & Co.) and the Passaic Rolling Mill Co. close competitors for second place. The delay in the award of the contract is due to an effort to combine the mason and iron work in one contract. It is estimated that the ironwork will cost about $800,000. Ex-Judge McQuade has the mason work.

Chicago, Kansas & Western R. R. Co.—It has been decided to consolidate into one company the following independent companies, which, as portions of the Atchison, Topeka and Santa Fé system, were organized during the past year, and on which construction is now being rapidly pushed: The Arkansas River and Western; the Walnut Valley and Colorado; the Pawnee Valley and Denver; the Independence and Southwestern; the Emporia and El Dorado Short Line; the Colony, Neosho Falls and Western; the Ottawa, Osage City and Council Grove; the Kansas, Oklahoma and Western, and the Chicago, Kansas and Western. The consolidated company will be known as the Chicago, Kansas and Western Company. The officers named are: Joab Mulvane, President; J. H. Griswold, Vice President; J. F. Scott, Secretary and Treasurer; G. L. Goodwin, of Boston, Assistant Secretary and Assistant Treasurer; and J. H. Whitehead, of Boston, Comptroller and General Auditor.

The Memphis & Little Rock R. R. is to be extended to Hot Springs, Ark., and ultimately to Sherman, Tex. This project is rendered necessary by the Missouri Pacific R. R. building a line from Bald Knob, Ark., on the Iron Mountain R. R., to Memphis.

The Tacoma Southern R. R. Co. has been incorporated in Washington Territory. The incorporators are: T. F. Oakes, J. M. Buckley, Nelson Bennett, C. P. Masterson and W. D. Tyler, and their purpose is to build a line from Tacoma, southward through a fine body of timber, to the bituminous coal fields in the foot hills of the Cascades. A preliminary survey for the line has been made and the route practically agreed upon.

Sanford & Lake Eustis R. R.—The bridge across the Wekiva, is now under way. Mr. T. H. Brown, who built all the bridges between Palatka and Sanford, including the two across the St. John's river, on the Jacksonville, Tampa and Key West R. R. has the contract. The bridge is 1,320 feet long and 22 feet high, with a 40-foot draw span for the passage of boats. The entire line to the Wekiva is now ready for the iron, and work is being pushed beyond the Wekiva river.

Fort Smith and Texarkana R. R.—A corps of surveyors, under the supervision of Col. Gus Noble, of Hope, Ark., left Texarkana, Ark., May 27, to make preliminary surveys of the proposed Fort Smith and Texarkana Railroad, and will push their work forward as rapidly as possible. The party expect to reach the terminus of the route—Fort Smith, Ark.—about the middle of June, when other measures will be adopted looking to more active operations. W. L. Whittaker, President of the Texarkana Northern Railroad, is now in the east, advising with capitalists as to the practicability of entering into the enterprise, which, as stated in previous dispatches, is an absorption of the company represented by him.

Mississippi Bridge at Memphis.—Investigation here discloses that the Kansas City and Memphis Railroad and Bridge Company was organized in the interest of the Kansas City, Springfield and Memphis Railroad Company and its Birmingham extension now under way. Mr. George H. Nettleton is President and Mr. Newman Erb, Attorney of both companies. The latter, interviewed here to-day, said that the Kansas City and Memphis Railroad and Bridge Company, has all the capital raised necessary to build a bridge across the Mississippi river at this place, and a belt railroad in connection therewith, and that as soon as Congress will pass the bill introduced, authorizing the structure, the construction will be proceeded with without delay. The bridge bill passed in 1884, known as the Casey Young bridge bill, has been offered his company, but it cannot be made available, because the grant by Congress was to two companies organized separately as private corporations in Arkansas and Tennessee. These have no authority to consolidate and cannot, being purely private corporations, exercise the right of eminent domain.

Mr. Erb says he understands that the Memphis Bridge Company, another company recently formed here with J. C. Neeley, S. H. Dunscomb, W. F. Taylor, L. B. McFarland and John Overton, with some New York parties as incoporators, have been presented or intend to have presented a bill in Congress for authority to build a bridge in opposition to his company; but he is assured that so far as the resident incorporators of that company are concerned, their enterprise is purely speculative. They have not been called on to invest any money in that enterprise and it is not intended that they should invest in it. They were requested to lend the use of their names in the interest of some parties in New York, about whose responsibility they have no clear knowledge, and they complied not knowing the intention of Mr. Nettleton in regard to the subject matter. Mr. Erb says that the rival company, if it may be so termed, is in the same predicament as the Casey Young companies. It cannot, under the constitution of Arkansas, condemn private property in that State, and cannot lawfully build or operate a railroad in either state. The grant to build a bridge would be worthless because it could not be made available; and the object of the people who are interested in having the bridge would be defeated. It is reliably reported also that the St. Louis, Iron Mountain and Southern Railroad Company is co-operating with Mr. Nettleton's company.—*Memphis Avalanche.*

Chicago & Northwestern R. R.—The Black Hills extension is being pushed at the rate of a mile a day.

The Missouri River Bridge Co., of Nebraska City, Neb., has been incorporated with a capital stock of $150,000.

Pittsburg & Northeastern R. R.—The Pennsylvania and Baltimore & Ohio railroads are both seeking to acquire control of this road which is projected to run from Pittsburg to Punxsutawney, a distance of eighty miles.

Railroad Land Grant.—The Minnesota Supreme Court has decided the Sioux City land grant test case adversely to the State, holding that the sale of the road to the Omaha Railroad Company did not forfeit the land originally granted to the former company.

Canastota Northern R. R.—A new survey has been made for that part of the road north of Fish Creek. The proposed new route is from Fish Creek to North Bay, and thence to Camden, instead of by way of South Corners.

Oregon Railroad and Navigation Company. The suit of Ervin and others against this company and Henry Villard has been decided at Syracuse in favor of the plaintiffs. Judge Wallace held Villard equally liable with the company. The amount involved is $1,500,000.

C. B. & Q. R. R.—C. C. Chandler, of the Chicago, Burlington and Quincy, and Superintendent of the Hannibal and St. Joseph railroads, and S. Crance have made a preliminary survey of a proposed branch of the road from Hamilton to Kingston, a distance of eight miles, and report the route very feasible.

An Inclined Plane Railroad.—G. W. Baxter, who is backed by Memphis capital, has petitioned the City Council of Hot Springs, Ark., for the right to build an inclined plane road at Eureka Springs to the top of the West mountain, where he proposes to erect an observatory and pleasure grounds.

Mexican Concessions.—The Governor of the State of Durango has been granted a concession for the construction of a railroad from the city of Durango to connect with the Mexican Central R. R. A steamship company has been granted a concession for a line between San Diego, Cal., and San José de Guatemala, the company to receive a subvention of $8,000 for each round trip.

Railroads for Persia.—Mr. Winston, the American minister at Teheran, states that the Shah is very anxious to have progress and public improvements in Persia, and to have aid both pecuniary and personal, from America for the development of the country; he is particularly desirous of having a railroad built from Mohammerah, on the Euphrates, near the Persian Gulf, to Teheran, and would be glad to have it built by Americans. Mr. Winston has asked for information relating to the commerce, etc., of Persia, and will forward the same to this country.

Tehuantepec Ship Railroad.—The Senate Committee on Commerce has presented a printed report to accompany the bill reported two weeks ago providing for a guarantee of $7,500,000 for the Eads ship railway. The committee says that surveys and profiles have been submitted to it, and that no swamp land is encountered on the proposed route. It regards the plan as entirely practicable. The capital required for a road to carry vessels weighing 4,000 tons is stated to be $7,500,000, but as the bill requires the transportation of vessels weighing 7,000 tons, a much larger capital will be required. The committee does not think that the Government will ever be required to pay any of the guarantee, and states that Government protection is necessary to secure capital. The session is now so far advanced that there is small prospect of the discussion of the bill in either house before next winter.

The Atlantic Avenue Elevated Railroad.—The plans and specifications for the proposed Atlantic Avenue Elevated Railroad in Brooklyn have been submitted to the Atlantic Avenue Rapid Transit Commission by Col. John Y. Culyer, the engineer of that body. The road is to extend from South Ferry to the city line; three tracks will be built from the ferry to Fifth avenue, and from there to East New York there will be four tracks; a double track will also run through Boerum place to connect with the Bridge. The structure will be built of iron and steel. One row of the supporting columns will be placed in the middle of the street, and one row at each sidewalk. At Kingston avenue it is proposed to have the road descend to the ground and form a temporary junction with the tracks of the Long Island Railroad Company. The locomotives are to be built expressly for the road and will have all the latest devices for the consumption and purification of smoke, the deadening of noise and the prevention of the dropping of cinders.

An Indiana Railroad.—A movement is on foot to build forty miles of road between Evansville, Ind., and Mount Carmel, where connection with the Chicago Cairo & Vincennes R. R. will be made. The movement is backed by the Chicago & Eastern Illinois Railroad Company and citizens of Evansville.

The Beach Creek, Clearfield & Southwestern Railroad Company has been sold under foreclosure and will be reorganized. The new company will be called the Beach Creek Railroad Company. W. K. and Cornelius Vanderbilt, it is said, will be in the new directory.

Atlantic & Pacific R. R.—The Senate has considered the Atlantic & Pacific Railroad Land Forfeit bill. After a few words of debate the bill was passed as it was reported from the Committee on Public Lands of the Senate. It forfeits all lands except the right of way adjacent and terminus with the uncompleted portion of road.

The Ohio & Northwestern Railroad Company has ordered a preliminary survey to be made from Gallipolis to Patriot, and thence to a point on the Portsmouth Branch of the C., W. & B. R. R. Capt. John J. Stack is chief of the corps; John D. Letcher and E. T. Shepard, topographers; Messrs. Burks and Nicholson, transitman and leveler.

The Pittsburg, Cincinnati & St Louis Railway Company has decided to widen and rebuild the Bulger tunnel, between Bulger and Burgettstown, W. Va., at once, and arch it with brick. The tunnel at present is arched with wood-work, and is only wide enough for a single track, the double track only running to its mouth. The intention is to build a double track through the tunnel and all the way out to Steubenville. The cost of widening and rebuilding this tunnel will be about $50,000.

Canada's Niagara Falls Railroad.—BUFFALO, May 27.—The Canadian Parliament has given a special charter to a number of Toronto and Hamilton capitalists to build a railroad through their Niagara reservation. These gentlemen visited Buffalo to-day to arrange for the work of construction. The line is from Table Rock along the Canadian bank of the river to Queenstown, directly opposite Lewiston. At Table Rock they propose to build an inclined railroad to connect on the bluff with the Michigan Central R. R., and to erect a grand hotel at that point. At Queenstown they will connect with the steamer "Chicora" and the Michigan Central R. R. again. The Canadians claim to have secured the co-operation of their Reservation Commission on the ground that the road will help to make the Canadian Park attractive, and they expect to get their right of way free.

The Fitchburg Railroad Accident.—The Railroad Commissioners have made public their finding in the case of the accident at Bardwell's Ferry on the State road on April 7, 1886, by which forty-seven persons were injured, of whom eleven were killed or have since died. After minutely detailing the location of the tracks and the circumstances of the accident, the Commissioners say: "The cause of the disaster was the slide of a part of the embankment, and the cause of this slide was the concurrence of three faults in construction. First, in 1866-68, when this portion of the road was reconstructed over the very imperfect road-bed of Messrs. Haupt & Co., a piece of crib-work was placed in the embankment, occupying considerable space midway between the track and river. This crib-work was afterward covered with earth and rock so that its presence was unknown to the present managers of the road. The contractor had forgotten it, and denied that there was any such work on the road, but after the accident the projecting ends of the timber revealed its existence, and an excavation has revealed its extent and character. The pins have rotted away, and the timber has greatly decayed."

The second contributory cause of the accident, the Commissioners say, was a neglect to provide an open culvert, by which the water accumulating in the ditch on the northerly side of the track would be drained into the river. This culvert was deemed necessary by the engineers in charge of "renovating" the road, but it was abandoned for some unknown reason.

The third defect was added when the second track was built in 1884. Much broken rock was dumped on the southern slope of the embankment, with an idea of strengthening and widening it. Such of the rock as reached the foot would aid in sustaining the bank, but that which remained high and dry over the weak spot would by its weight become a source of danger and co-operate with the water in producing the final disaster.

The three causes together were needed to produce the sad result, and altogether they abundantly account for it. There is no evidence of any negligence or fault on the part of the Fitchburg Railroad Company, or any one in its service, and the present State road officials appear to have exercised every possible precaution for the safety of trains. The Commissioners call especial attention to the heroism displayed by Engineer Littlejohn at the time of the accident, and to the services rendered by other train employés who were themselves suffering from injuries.

Street Railroad.—Messrs. Charles and James Raymond, contractors, of Brooklyn, representing a New York syndicate, have been in Plainfield, N. J., in the interest of a street railroad project.

The Arkansas Valley R. R. Co., whose right of way through the Indian Territory has recently been granted, is making preparations for the commencement of work on the western extension.

The Milwaukee & Whitefish Bay Railway Company has been incorporated by William H. Bradley, Guido Pfister, P. V. Deuster, J. H. Lowry, Otto Z. Wietusch, Richard Barke, T. W. Williams, J. V. Dapre, and Valentine Blatz. The capital stock is $50,000, and the object is to build a dummy railway between Milwaukee and Whitefish bay.

The Chicago, Milwaukee & St. Paul R. R. Co. has let sub-contracts on a number of sections of the new extension from Ottumwa, Ia., to Kansas City, and a number of contractors have already gone to work. The sub-contracts are scattered along the line, and it is stated to be the intention to complete the line within a year.

Piqua & Troy R. R.—The right of way for the proposed Piqua & Troy Branch Railroad has been secured and is now ready for the work of construction to begin. The people of both towns have done all they agreed to do, and now the Hamilton & Dayton R. R. Company is expected to go to work and build the road without delay.

Parsons & Pacific R. R.—PARSONS, Kan., May 21.—Contracts were let to-day for the construction of thirty miles of the road. These contracts are let under an iron-clad agreement that the construction shall be in every way first-class. They include grading and equipping. President Mirick has resigned and Vice-President C. H. Kimball has been elected president.

The Pacific Coast Railroad, which runs from San Luis Obispo, Cal., to Las Alamas with a branch to Port Hartford, is about to resume construction. The Oregon Improvement Company, which owns the road, is credited with a desire to head off the Southern Pacific R. R. by building a line into Santa Barbara, via Gaviota Pass. Surveyors are said to be in the field for this purpose.

Bridge Expansion.—A part of the masonry of the West Shore railway bridge across the creek west of Port Jackson, N. Y., has been found to be defective because the two walls were built too near each other, so that the iron stringers on which the bridge superstructure rests have not sufficient room for expansion and they warp in consequence. The outer wall is being taken down and will be rebuilt.

Hudson River Tunnel.—There is reason to believe that work on the Hudson river tunnel, will soon be recommenced. According to a very credible rumor, the New York Central, the Pennsylvania Central and other roads which bring freight and passengers to the New Jersey river front have joined hands to help forward this enterprise. It is said land has been bought commanding the approaches to the tunnel on the Jersey shore.—*Record and Guide.*

Pennsylvania Schuylkill Valley R. R.—The tracklayers on the Pottsville extension have reached the deep cut north of Hamburg, where their progress is impeded by the heavy landslides that are continually retarding the work of completing the cut. The tracklayers working on the northern end of the line, from New Boston to Pottsville, are making rapid progress and will reach the St. Clair tunnel, which is also unfinished, within a few days. Surveyors of the Pennsylvania R. R. have located the line to connect this road with the North and West Branch R. R. The route is along the Nescopeck creek, and the right of way is now being acquired.

Canadian Pacific R. R.—Simultaneously with the construction of the bridge from Montreal to the south shore of the St. Lawrence, a short line of about eighteen miles will be built from the south end to St. Johns, to connect the Canadian Pacific system with the Delaware and Hudson, the Central Vermont and the South-Eastern railroads. To reach these systems now it has to pay toll to the Grand Trunk R. R., which owns in the Victoria bridge the only rail crossing on the whole length of the St. Lawrence river. The completion of this bridge and short lines will therefore give the Canadian Pacific in connection with the South-Eastern Railway, which it owns, an independent through route from Vancouver, on the Pacific coast, to Boston. The construction of a road across the State of Maine, already chartered, will connect the system with St. John and Halifax. Within a year, therefore, the Canadian Pacific will have independent lines and connections of its own from all western points to the summer ports of Montreal and Quebec and the winter ports of St. John, Halifax, Portland and Boston.

Denver, Memphis & Atlantic R. R.—Track-laying egan recently at Chetopa, Kan., and will continue at the rate of over a mile a day for the remainder of the year. There will be about 200 miles of track laid this year.

The Toledo, Charleston & St. Louis R. R., formerly the Toledo, Cincinnati & St. Louis Narrow Gauge, is to be widened to standard gauge during the present year, and it has been fully decided to inaugurate the work at once. All arrangements for delivering the ties have been consummated, and they will at once be scattered along the line of the track. Arrangements are now being made to strengthen and improve all bridges on the line.

Storm King Bridge Connections.—MIDDLETOWN, N. Y., May 21.—There are significant movements afoot in connection with the projected bridging of the Hudson at Storm King and Breakneck mountains. Some years ago a syndicate of New Jersey and Boston capitalists undertook to build a road styled the Pennsylvania, Slatington and New England Railroad on nearly an air-line route across Northern New Jersey, and connecting the Lehigh Valley Railroad system at Slatington, Pa., with the Erie Railway system at the New York State line, near Liberty Corners, N. J., and thus reaching the great Hudson bridge. The work of building the new road was pushed forward until a large portion of the New Jersey section had been graded ready for the rails. At this point the construction fund gave out, and the work came to a standstill. After a long period of inaction renewed interest in the enterprise has recently been developed by the proprietors, old claims of contractors and others have been settled up, and the engineers have resumed operations. The Erie Railroad Company, apparently acting in concert with the projectors of the new road, has set a corps of engineers at work laying out the route for an extension of their Pine Island branch, eight miles from the present terminus to the State line, at the point named for the junction of the two roads. It is given out that the Erie extension will be built at once, and the Jersey people interested look for an early resumption of work on that portion of the line. The Pennsylvania Railroad has also apparently in view a connection with the proposed Storm King bridge. A corps of the company's engineers is engaged making preliminary surveys between Dover, N. J., and Cornwall, N. Y.

Stations of Coast Survey Vessels.

W. H. Brownson, Lt. Comdr. U. S. N., Hydrographic Insp'r Lt. J. F. Moser, U. S. N., Coast and Geodetic Survey.

Steamer *A. D. Bache*, Lieut. J. M. Hawley, U. S. N., commanding. Address Bayport, Hernando Co., Fla.

Steamer *G. S. Blake*, Lieut. J. E. Pillsbury, U. S. N., commanding. Address Charleston, S. C.

Schooner *Eagre*, Lieut. Chas. P. Perkins, U. S. N., commanding. Address Station M. New York.

Schooner *Earnest*, Lieut. C. T. Forse, U. S. N. Address Port Townsend, Wash. T.

Steamer *Gedney*, Lieut. F. H. Crosby, U. S. N., commanding. Address Navy Yard, New York.

Steamer *Hassler*, Lieut. E. D. Taussig, U. S. N., commanding. Address Box 2402, San Francisco, Cal.

Steamer *M'Arthur*, Lieut. J. M. Helm, U. S. N., commanding. Address Navy Pay office, San Francisco, Cal.

Steamer *Patterson*, Lieut. Comdr. A. S. Snow, U.S. N., commanding. Address Navy Pay Office, San Francisco, California.

Steamer *Endeavor*, Lieut. G. C. Hanus, U. S. N., commanding. Address Bath Beach, King's Co., New York.

Schooner *Scoresby*, Lieut. Francis Winslow, U. S. N., commanding. Address Beaufort, Cateret Co., N. C.

Steamer *Arago*, Lieut. Geo. H. Peters, commanding. Address Corsfield, P. O., St. Marys Co., Md.

Schooner *Palinurus*, Lieut. D. D. V. Stuart, commanding. Address So. Norwalk, Conn.

Street Accidents in Paris.

Now M. Drumont is nursing the wound in his thigh, while the whole camp of Israel is resting upon its arms awaiting the result. Occasionally, but not often, some one gets severely injured in these sentimental encounters.

Upon the whole the danger is not equal to that of crossing the crowded streets. Last year in Paris I devoted a paragraph to the consideration of the recklessness of the drivers and the peril of pedestrians. Afterwards an ordinance was issued, on the complaint of some foreign gentleman, intended to mitigate this evil. But it was a Lomb without a fuse. No driver paid to it the least attention, and no policeman exerted himself to carry it into effect. Still, as before, may be seen anxious crowds upon the sidewalks waiting for a chance to skip to one of those blessed little islands of rest in the middle of the thoroughfares. Having reached it in safety, foot passengers gather about its central lamp-post and watch their chance for another run. Frequently people are knocked down and run over, and if they appeal to the magistrate, they are dismissed with a warning to be more careful in future.

Sometimes the vehicles collide. The other day we saw one of those heavy omnibuses with three horses abreast driving rapidly down the Rue de l'Opéra. A fiacre was crossing it from the Rue de la Paix, and they came in contact. Instantly four policemen were on the spot, each of them pulling out his note-book, and all of them together calling upon the omnibus driver and the cabman to *constater* how the thing occured. They all talked at once and the memoranda were duly made. It seemed to us that if these policemen had been doing their duty in preventing the accident, the note-books might have been dispensed with. All the bystanders were called upon to *constater*, and those who did so were notified to appear at the tribunal. Although we saw it all, I did not care to be a witness, but I did feel a curiosity to know the result.

I think the judge must have had some maritime experience. There was no question of side-lights, for it happened in broad daylight. The main query before the judicial mind was, "Where was the point of contact of the omnibus poles with the fiacre?" "Did they strike the horse?" "No, the horse went clear, and so did the driver." "Then did the poles strike the *juste milieu* of the fiacre, or was the blow given forward or abaft it?" "Abaft." "How many centimetres from the *juste milieu*?" "We did not measure, Monsieur, but the hind wheel was knocked off." "That settles it. The fiacre had the right of way, and the omnibus must pay for the damages." Most righteous judge! But supposing it had been a lady instead of a fiacre, and that appendage of a fashionable woman, which is not a part of the woman herself, had been carried away, how would you have decided the case by the rule of centimetres?—Correspondence *Evening Post*.

Market Report of Engineering Materials.

New York June 3, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles		2.00c	@ 2.10c
" steel		2.35	@ 2.45
Tees		2.40	@ 2.45
Beams and channels, American		3.0	@
Tank plates		2.13	@ 2.20
Shell plates		2.4	@ 2.5
Steel plates, Tank		2.70	@ 2.75
WROUGHT-IRON PIPE. PITTSBURG.			
Butt welded, black	Discount	42½	@ 45
" " galvanized	"	57½	@ 35
Lap welded, black	"		60
" galvanized	"		42½
Boiler tubes	"		52½
RAILS.			
Steel (large lots at mill)		$34.50	@ $35.00
Old rails		18.50	@ 19.00
Old rails, steel		22.06	@ 23.00
R R. spikes		2.150	@ 2.25c
R R. splice-plates		1.70	@ 2.00
R R. track bolts, square nuts		3.00	
Barb-wire fencing, galvanized		4.38	
" painted			4.00
Corrugated iron			
Nails			
Iron, per keg		1.90	@ 2.10
Steel do.		2.55	@ 2.60

METALS.

COPPER.		
Lake Superior	10.00	
Other Brands	9.50	@ 9.75
LEAD.		
Com. Domestic	4.70	
Lead Pipe	.06¼c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	$5.50	@ 5.70

BRICK.

Cargoes (afloat)		
Haverstraw per M.	7.00	@ 7.75
Fishkill	7.25	
Up-River	6.75	@ 7.00
Jerseys	5.50	@ 6.25
Long Island		
Pale	4.50	@ 4.75
FRONTS.		
Croton, red	12.00	@ 15.00
" dark	12.00	@ 15.00
" brown	11.00	@ 14.00
Philadelphia pressed	24.00	@ 25.00
Trenton "	24.00	@ 25.00
Baltimore "	37.00	@ 41.00
Buff "	33.00	@ 35.00
Enameled English	85.00	@ 130.00
" American	80.00	@ 120.00
Fire brick	24.00	@ 55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50	@ $3.00
BARTJER & MEYERSTEIN:		
Hanover Portland	2.60	@ 2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
K. B. & S.	2.55	@ 3.00
BROOKS, SHOOBRIDGE & Co.	2.45	@ 2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs.	2.50	@ 2.75
K. B. & S. " "	2.65	@ 3.00
Stettiner, German	2.65	@ 2.85
Lagerdorfer, "	2.45	@ 2.75
Fieve, A 1, Belgian	2.35	@ 2.50
Roman	2.75	@ 3.00
Keene's Coarse	4.75	@ 5.50
" Fine	7.75	@ 8.50
" Superfine	8.50	@ 10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	$2.40	@ 2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65	@ 3.10
HUDSON RIVER CEMENT Co. Rosendale		0
JOHNSON & WILSON:		
Saylor's American Portland	2.15	@ 2.40
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20	@ 2.40
Improved "Union"	1.25	@ 1.50
Union	1.10	@ 1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse Keene's	4.25	@ 4.50
" Superfine	7.25	@ 7.50
" Portland	2.45	@ 2.85
NEW YORK CEMENT Co.:		
Rosendale		1.10
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAUSON:		
K. B. & S.	2.35	@ 2.60
STANDARD CEMENT Co		
E. THIELE:		
Dyckerhoff	2.90	@ 3.25
UNITED STATES CEMENT Co.:		
English Portland	2.25	@ 2.40
German "	2.00	@ 2.15
Standard	1.50	@ 1.65
Windsor and Improved Rosendale	1.00	@ 1.10
UNION AKRON CEMENT Co.:		
Akron "Star" brand		

ASPHALT.

ROCK.		
Prices range per ton	$15.00	@ 20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50	@ $3.50

LIME.

Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	.95	@ 1.00
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95	@ 1.00
" " No. 2 "	0.75	@ 0.85
" " light drab "	0.80	@ 0.95
Berlin " in rough "	0.75	@ 1.00
Berea " "		
Brown stone, Portland, Ct. "	1.00	@ 1.35
" Belleville, N. J. "	0.75	@ 1.35
Granite, rough "	0.45	@ 1.25
Common building stone per load	2.00	@ 3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@ 3.00

SLATE.

Purple roofing per square	6.00	@ 7.00
Green "	6.00	@ 7.00
Red "	15.00	
Black Penna. (at New York) "	4.50	@ 5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@ 20.00
Choice "	65.00	@ 70.00
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@ .50
Tally boards, dressed com. "	.28	@ .30
SPRUCE, Boards dressed "	.25	@ .28
Plank, 1¼ in "	.28	@ .30
" 2 in. "	.38	@ .40
" 2 in. dressed "	.43	@ .45
Timber per M.	13.50	@ 16.00
HEMLOCK, Boards each.	.18	@ .20
Joist, 2½ × 4 to 4 × 6 in	.16	@ .44
OAK per M.	55.00	@ 65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00	@ 40.00
YELLOW PINE, Girders "	25.00	@ 30.00
Dressed flooring "	28.00	@ 35.00
SHINGLES, Extra shaved, pine, 16in. "		
" sawed 18 in. "	5.75	@ 6.00
LATH, Cargo rate "	2.25	@ 2.40

PAINT.

Lead, white, American dry per lb	.04¾	@ .06¾
" " " in oil pure "	.07	@ .07½
" English, B. B. in oil "	.08¾	@ .08¾
" Red, American "	.05¾	@ .06
Litharge "	05¾	@ .06
Venetian red, American "	.01	@ .01¾
Indian red "	.08	@ .10
Vermillion, American lead "	.10¾	@ .11½
Paris green "	.15	@ .18
Umber, Amer. raw and powdered per lb.	.01¾	@ .01¾
Drop black, Amer. "	.07	@ .13
" " Eng. "	.11	@ .13
Chrome green "	.10	@ .25
Oxide zinc, American "	.03½	@ .03¾
" French "	.05½	@ .07½